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NEW YORK, SATURDAY, JANUARY 14, 1905.

CONTENTS.

Editorial 85
Large Independent Telephone Consolidations 88
Power from the Ohio River 88
Lectures at the Brooklyn Polytechnic 88
School of Applied Electricity 88
Recent Use of the Telephone 89
Telegraphing Bets Illegal 89
Electricity and Automobilism 89
New York Electrical Society 89
Efficiency of Human Energy 90
Trees in Wireless Telegraphy 90
Growth of Bell Telephone 90
Electrical Engineers of the Times—II. Putnam A. Bates 90
Current News and Notes 91
A London Electric Railway Power House 93
Commutation at Starting of Alternating-Current Motors with Commutator. By Marius Latour 97
Comparison of Alternating-Current Railway Systems. By J. H. Hallberg 99
The Electrical Testing Laboratories—II. By Clayton H. Sharp..... 102
New College of Engineering. The George Washington University, Washington, D. C. By N. Monroe Hopkins, Ph.D. 105
New Telephone Patents 107
LETTERS TO THE EDITORS:
A Theory of Gravitation. By S. Tideman 108
Power-Factor Meter. By Paul MacGahan 108
Digest of Current Electrical Literature 109
Book Reviews 113
Switch and Panel Board Engineering. By B. B. Hatch 113
Mercury Tubes in a Newspaper Pressroom 114
Triumph Variable-Speed Motor 115
Testing Clip 116
Sparking Coils for Automobiles 116
Non-Interfering Telephones 117
Automatic Time Switches 117
Theatre Dimmer 118
Vertical Automatic Engine Set 118
Wood Turning Lathe 118
New Watertown Engine 119
General News of the Week 120

REPORT OF THE DETROIT LIGHTING COMMISSION.

The ninth annual report of the Public Lighting Commission of the city of Detroit, Mich., which has been issued for the year ending June 30, 1904, shows, unfortunately, the usual disregard for depreciation of the city's lighting plant that is exhibited by municipal authorities generally in making reports of the cost of lighting from municipally-owned plants. As regards the present practical management of the plant in Detroit, we know but little, and are in no position either to criticise or to commend, but the policy of the Lighting Commission in publishing such figures as appear in its last and other annual reports is certainly on the face of it open to severe criticism. In giving the cost per arc lamp per year the Lighting Commission figures depreciation on the plant at 3 per cent. on the investment, which comes to $8.32 per lamp. The depreciation on discarded machinery is only 47 cents per lamp. If private plants could safely figure on 3 per cent. depreciation, what a bonanza the electric lighting business would be! The Detroit plant was originally equipped with direct-current arc machines. As the extensions are being made with alternating-current arcs, supplied from constant-potential generators, the direct-current part of the plant, excellent as it may be, is practically obsolete, and if sold to-day would only be worth its price in junk, because of the advance of the art. Yet it is being carried on the books of the Lighting Commission from year to year with but 3 per cent. yearly depreciation. If the Lighting Commission would have made an accurate inventory of its apparatus by some disinterested expert familiar with values, the depreciation account would look very different.

RAILROAD AND TELEGRAPHIC RIGHTS OF WAY.

The recent decision of the Supreme Court of the United States in the case of the Western Union Telegraph Company against the Pennsylvania Railroad Company, contains matter of considerable public interest. It will be remembered that at the termination of a certain contract period between the two companies referred to, the railroad company desired the telegraph company to remove its poles and wires from the road. The telegraph company appealed to the courts, however, contending, in substance, that railroads were public highways, and that consequently the laws which permitted telegraph companies to erect and maintain poles and wires on public highways permitted them to do so also on railroads. This contention the Supreme Court denies, on the grounds that a railroad is not public property. It would seem, therefore, that just as no man is entitled to walk or drive along a line of railway, so also no man has a right to erect or maintain telegraph poles along it without the consent of the railroad company.

Every year makes the rights of way for pole lines more difficult to secure along highways in settled parts of the country. This seems inevitable, and is one of the incidents of dense civilization. There ceases to be room for all the wires overhead, apart from questions of danger or æsthetics. If the wires can be put underground profitably, there is much less difficulty in securing rights of way, and where the streets are thickly built up, the expense of going underground becomes possible for the community to bear. But the signaling wires suffer materially, even if the cost of going underground can be defrayed. The extra capacity of subterranean wires heavily handicaps them for long-distance telegraphy, even with the most recent improvements in that direction. The difficulties in the way

of securing sufficient privileges for carrying pole-lines may at some future time considerably aid the cause of wireless telegraphy.

The East Boston Tunnel.

The final word of 1904 on rapid transit is the completion of the tunnel and subway between Boston proper and East Boston, once known to fame as Noddle's Island. This enterprise has just squeezed into the records of the year 1904 by about forty-eight hours, it having been thrown open to the public on December 30 after an official opening the day before. In some respects it is particularly worth notice, and although it can have no such sweeping result in rapid transit as belongs to the metropolitan subway, it will, of course, prove of vast convenience to those who, like the retiring Governor of the Commonwealth, have cast their lot with this busy outlying section of Boston. East Boston has heretofore been exceptionally isolated on account of the long arms of the sea that cut it off and has been reached mainly by a none too convenient system of ferries. About seven years ago the present tunnel was authorized and about four and one-half years ago the first contract was signed. Since that time work has been steadily pushed along, foot by foot, through the land which Boston has wrested from the sea and then under the sea itself until the peninsula was finally joined to the island. It is more than a year since the excavations met, but no small amount of time has been needed for stations, approaches and the tedious final work of completion. Now it is doing business under the effective administration of the Boston Elevated Railway Company, and forms another link in Boston's underground rapid transit system.

The tunnel is only of moderate length, about 1.4 miles, but is of exceptionally great cross-section and has very complete provisions for ventilation and drainage. It extends from Scollay Square, in the city proper, to Maverick Square (named for the first resident of the island) in East Boston. The running time is about seven minutes between these points, instead of the twenty minutes or so previously needed to work the combination of cars and ferries. About 4,000 ft. of the tunnel is fairly under the harbor, but nearly the whole of it is virtually submarine by reason of the nature of the ground. The tunnel touches a point some 90 ft. below mean high water and runs generally from 20 to 30 ft. below the bottom of the harbor. Its most notable feature is its very large area. It is an arched structure 17½ ft. high in the center above the bottom of the car tracks, and about 23½ ft. wide. It has an effective area of 358 sq. ft., making it a shade larger than the great Blackwall Tunnel under the Thames, and by that shade the largest submarine tunnel yet constructed. It is, in fact, nearly 10 per cent. larger in area than the Boston Subway itself, being intended to accommodate rapid transit cars of the largest size, while the situation demanded a deeper arch for the roof. This of itself should give easier ventilation than is usual underground, but to make sure of good air in the long submarine section, a special ventilating flue was formed in the upper part of the tunnel arch having an area of 48 sq. ft. and provided with suitable openings and with fan capacity enough to insure plenty of fresh air under any conditions. The electric service is for the moment being carried on by fine long cars of the latest type borrowed from the surface lines, but these will soon be replaced by the special cars that have been temporarily delayed. The tunnel is certainly exceptionally well lighted, ventilated and equipped and Boston may well be proud of it and consider it as three million odd dollars well spent.

It is not our intention here to go into details of description that belong to a technical article, but we do want to call attention to the good points of such a tunnel as compared with any sort of overhead communication. When a city is situated in an area cut up by navigable waters, bridges are expensive and troublesome. Either they have to be carried at enormous heights like the East River bridges or they have to be provided with draws, which when in use hold up traffic completely. New York took one horn of the dilemma, Boston took the other on the main line of its rapid transit system, and while careful regulation of marine traffic has reduced the drawbridge difficulty to a minimum, it still exists. A tunnel, on the other hand, interferes with nothing and is a slave to nothing. The success of rapid transit through it depends on the skill with which the traffic is organized, not upon external conditions. Costly as it is, a tunnel, be it under ground or under water, is by far the most finally satisfactory means of securing rapid transit. This has in no wise been more effectively shown than in our metropolitan Subway. We extend sympathetic congratulations to our Boston friends. They have done the right thing and have done it remarkably well.

Recent Results of Magnetic Observations.

The recently published report for 1904 of the annual results of magnetic observations, by the Coast Survey, is a useful document to magneticians. It contains, in tabular form, the results of over 1,200 reported observations of dip, declination and intensity during the year. About 10 per cent. of the observations were made at sea. The observations at sea are made relatively difficult and uncertain, partly by the motion of the vessel and partly by the magnetism of the vessel. Consequently, while the dip and the declination can be readily determined on land to within two minutes of arc, the corresponding observations at sea, under favorable conditions, are often uncertain to about a quarter of a degree. The observations were made at 384 land stations, from the Philippines in long. E. 125°, to Porto Rico in long. W. 65°, these extreme longitudes being nearly opposite to each other. The stations also range in latitude from Alaska 58° N., to the Philippines 8° N. The horizontal intensity was greatest in the Philippines, reaching nearly 0.39 gauss. It was least in Alaska, at 0.01 gauss. The last-named observation, taken near Juneau, was near to what might be regarded as a local magnetic pole of the earth, the dip there being recorded as almost 90°. The smallest recorded dip was 4°, at one of the stations in the Philippines. No observations are recorded for New York State, but at Sandy Hook, N. J., near New York, the horizontal intensity is recorded in September, 1903, as nearly 0.189 gauss, the dip 71° 41′ and the declination 8° 53′ W.

The observations of the magnetic survey conducted in Louisiana are mentioned as possessing special interest. It seems that near New Orleans the magnetic declination was observed to reach a maximum of some 8¾° E. about the year 1830. According to the secular changes of magnetic declination, as determined from experience in the Atlantic States, the declination at New Orleans should go on diminishing, by about three minutes of arc annually, until some time near the middle of the present century. Louisiana seems, however, to have seceded from the Union in a magnetic sense, because it is stated that the needle reached its western limit six years ago, then standing at 5½° E. declination, and is now going back eastwards, at the rate of 1½ or 2 minutes of arc annually. Whether Louisiana means to keep on her eastward career, or whether she intends to halt and join the magnetic tendency of the Northern States, is a question that the magneticians are at present unable to answer.

The value to communities of frequent and careful magnetic observations all over the country is, however, indicated by this seemingly erratic magnetic behavior of Louisiana. It is pointed out in the report that values of the magnetic declination secured there forty or fifty years ago, if referred to the present time by applying the secular variation, in accordance with the experience in other parts of the United States, would result in an error of from half to one-

third of a degree, a very appreciable quantity in land surveys. It is also pointed out that the magnetic charts of Louisiana prepared from the recent survey indicate local irregularities in the earth's magnetic distribution, chiefly in the regions of the alluvial deposits brought down by the Mississippi River. It is suggested as likely that these irregularities are due to small local deposits of iron ore brought down from the upper States by the Mississippi River, and deposited in these regions.

THE ELECTRICAL TESTING LABORATORIES.

On page 102 appears the second section of an article by Dr. Clayton H. Sharp, describing the Electrical Testing Laboratories of New York. In London there are the Board of Trade Laboratories, in France the Laboratoire Central, in Berlin the Reichsanstalt. New York now offers parallel facilities for the electrical engineering industries. The advantages of the site of these laboratories is that they are sufficiently near the industrial center of Manhattan Island to be readily accessible by visitors. At the same time they are sufficiently remote from electric cars and heavy traffic to permit of the use of delicate apparatus. Moreover, the location of the plant within easy range of the main generating plant of the New York Edison Company, enables the laboratories to receive the power they require through underground conductors, without the inconvenience of producing it locally. Such production is usually accompanied by dust, smoke and vibration, to the prejudice of delicate apparatus. The equipment for testing lamps, meters and instruments of all kinds is very complete. As described in the article, excellent facilities are offered for conducting high-pressure tests, both by direct and alternating currents. The photometric testing rooms are probably the finest of their kind, and no pains have been sacrificed to render them efficient and the measurements accurate. The integrating photometer for measuring the mean spherical candle-power of arc or incandescent lamps is especially interesting.

Laboratories of this kind possess a national right to recognition, in addition to their industrial or commercial importance. The function of a laboratory of this character admirably supplements the work of the National Bureau of Standards at Washington. The best work of the National Bureau is naturally directed toward the determination, maintenance and distribution of primary and secondary standards of measure, not only in electrical but also in physical, chemical and mechanical industries. The best work of the Electrical Testing Laboratories of New York is naturally directed toward receiving the primary and secondary electrical standards from Washington, and redistributing to the electrical public secondary and tertiary standards, besides making the numerous local applications of those standards which the electrical industries require. In other words, it is the best purpose of the National Bureau to determine and issue fundamental United States standards of volts, amperes, ohms, etc. It is the best purpose of the New York laboratories to apply these standards for the electrical public in the numerous methods that the industries require. This function is of very great value to the progress of electrical arts and sciences.

AN INTERESTING EDUCATIONAL EXPERIMENT.

As noted elsewhere, there is about to be opened under the auspices of the Boston Young Men's Christian Association what might perhaps best be styled a preliminary practical training school of applied electricity. The Boston Y. M. C. A. has made much of practical education, and last winter opened a school of instruction in motoring which scored an immediate and distinguished success. This year's electrical school necessarily covers a wider ground, but is to be conducted along similar practical lines. It is not a trade school, for it does not devote itself to turning out electrical workmen, but is intended to give those who are daily confronted with applications of electricity a chance to learn what it is all about, in a thoroughly practical manner, and in addition to give beginners preliminary instruction that may lead them to a further technical training. To this end the courses include both lectures and laboratory work, given in the evening to accommodate those who are busy by day, and will be made as simple and practical as possible. The lectures are intended to meet the requirements of those who have no knowledge of mathematics beyond arithmetic, and the laboratory courses, while of necessity elementary, will deal so far as possible with apparatus in its actual commercial forms. A number of the large electrical concerns in the vicinity have come generously to the front with apparatus and have taken a keen interest in the enterprise, which is under the general charge of Prof. W. L. Puffer, of the Massachusetts Institute of Technology, who has for many years been in touch with allied work connected with the Lowell Institute and other movements for popular education.

It is intended to make the school self-supporting as far as possible by charging a small tuition fee, as in the other educational work of the Y. M. C. A., although there is plenty of substantial backing to see the enterprise through. There have been a considerable number of elementary and trade schools started which are doing capital work in this and other cities, but the Boston experiment apparently is along somewhat different lines from those usually followed. An attempt is to be made to meet individual needs so far as is practicable and to give a chance for practical instruction, not so much in the elements of electrical science as in the electrical arts, as followed in everyday life as well. There are many men indirectly connected with the applications of electricity whose necessities are not met by the ordinary elementary class in electricity. They need its preliminary training, but they also need the concrete practical information which can only be gained by laboratory work of a sort rarely possible in elementary schools. The uses of electricity in daily life are so many and so varied that they are continually before those who have not the time or the schooling to get at them via the ordinary technical course. Some of these cases are met by the correspondence schools, but in the very nature of things these cannot give the laboratory instruction that is especially necessary to those whose opportunities are limited. We are glad to see so practical a movement as that just started and certainly wish it abundant success.

If a boy sees that the way is not open for a higher education he is more than likely to drop out of school early and "go into business," which means in these days that he tumbles into the first job that an untrained boy can get and either is entirely lost to the technical trades or works into one of them at a hopeless disadvantage. In this way much good material is lost. There is a steady demand for men with at least the rudiments of technical training as foremen, shop manager and the like, and the present supply is altogether inadequate. As we have many times intimated, in trying to train men for captains of industry we neglect the opportunity to provide first-class corporals and sergeants of industry. A few men pull up from the ranks by their own efforts, but there is great need for methodically helping them—for institutions frankly devoted to rudimentary work. Some there are of which the country may be justly proud, but we need more of them—many more. For every technical school of collegiate grade three or four elementary schools are required. At the present time this ratio is just about reversed. Schools like the one which forms the text of this comment can do a very useful work in repairing the faults of the past. An ounce of prevention, however, is worth a pound of cure, and with well-organized elementary technical schools a young man could get a fair start and would not need the help that an evening school is fitted to give him, or which the correspondence schools do so well.

Large Independent Telephone Consolidations.

Details are given by the newspapers of the Middle West as to deals and sales in relation to a number of independent telephone plants, the moving parties in the transactions being what is known as the Barber & Brailey syndicate, which centers chiefly at Toledo, Ohio. About two weeks ago T. H. Ferris and C. H. Poole, representing a syndicate of Rochester and Utica capitalists, went to Toledo and purchased Barber & Brailey's interest in the Herkimer (N. Y.) Independent Telephone Company. The promoters in question said that their syndicate had organized a holdings company with a paid-up capital of $5,000,000 and represented a controlling interest in a number of independent telephone companies in central New York, including the Utica and Herkimer companies. This holdings company also controls a number of important toll lines, including the one running from Utica to Rochester. A similar deal is pending for the consolidation of a number of independent telephone companies outside of Toledo but in Ohio, and including among others the Springfield & Xenia plant. This latter property has made a good record for the year. The bonds which were but recently sold at from 65 to 68 are quoted in Cleveland at 90 for the bonds and 15 for the stock. Another deal of almost equal if not greater importance was the purchase by the Barber-Brailey syndicate operating in Hot Springs, Ark., of the Bell Telephone plant at that place. In this connection the *Sentinel Record*, of Hot Springs, Ark., says: "The meeting of the board of directors of the Southern Telephone Company yesterday afternoon, at its offices in this city, was a very satisfactory one and means much for the good of the telephone service of Hot Springs. The purchase of the Southwestern system was consummated and by February 1, 1905, all of the subscribers of the old company will be taken into the new service with entirely up-to-date telephones. By February 1 Hot Springs will have a system of 1,500 telephones and a company in which local capital will be largely represented. At a meeting of the Southern company yesterday afternoon C. N. Rix, president of the Arkansas National Bank, was elected to the board of directors and C. F. Cooley, secretary of the Business Men's League, was made secretary and it is the intention soon to enlarge the board by the addition of other prominent citizens. The directors also declared the first semi-annual dividend, which was 2 per cent. on the stock. The plans for the near future contemplate many additions and improvements in the facilities. The president and vice-president left last night for Chicago to make arrangements for enlarging the switchboard to nearly double its present capacity and many other additions will be made to the service, which will be second to none anywhere."

"The Southern company referred to was recently organized by the Barber & Brailey syndicate and has been a winner from the start. The company has a capital of $170,000 with a bond issue of a similar amount. With the stock paying 2 per cent., the bonds, some of which have been placed here, should be worth at least par."

Power From the Ohio River.

A rather large scheme of water power development is included in the present River and Harbor bill before Congress. It applies to the canalization of the Ohio River, and involves an expenditure of between $40,000,000 and $60,000,000. An appropriation of $382,000 is recommended by Major Sibert, the engineer in charge of the work in the Pittsburg district, for the purpose of changing the first six dams in the Ohio, between Pittsburg and Beaver Falls, so as to create pools of at least 9 ft. depth on the miter sills. Some of the engineers on duty there, however, have grave doubts as to whether that sum is sufficient to so change the six dams under consideration so that Pittsburg will have a harbor twenty-odd miles long, with 9 ft. of water all the time. All the dams are under construction and three are completed, but Major Sibert believes he can rip them out and lower their sills at a comparatively small cost. He has no doubt that he can put in the dams now far advanced in construction at a very small increase over the original estimate of cost.

The present plan for the improvement of the Ohio contemplated the construction of thirty-seven dams between Pittsburg and a point a short distance below Cincinnati, each to cost from $700,000 to $1,250,000, exclusive of land. The total estimated cost was a trifle less than $20,000,000. But it provided for only 6 ft. of water. The new plan provides for a 9-ft. channel, beginning with the enlargement of the harbor of Pittsburg, and, as appropriations are secured, the changing of the dams further down the river, so that they will carry 9 ft. of water. By increasing the depth of the first six dams, an immense storage pool, or rather succession of storage pools, with power possibilities, will be created for the coal that goes down the Monongahela, amounting to more than 12,000,000 tons annually. It can be held there until the water below Beaver Falls rises to a height sufficient to carry the barges to New Orleans.

Lectures at the Brooklyn Polytechnic.

January 5 Prof. W. S. Barstow gave a lecture on "The Steam Plant," the third in his course on central station practice. Load curves for a hydro-electric central station were presented, showing how the inequalities of the loads at different times of the day and at different seasons of the year have been overcome by the installation of a steam-driven generating set. The lecture was illustrated by a number of lantern slides, showing cross-sections and general arrangements of the various kinds of apparatus used in a typical central station.

Among the subjects considered by Prof. Barstow were the following: Methods of conveying coal or other fuel and means for burning it, involving the choice of various types of furnaces and boilers; the use of superheated steam; selection of valves; layout of piping; size and type of prime-movers; open and closed feed-water heaters, condensers, fuel economizers; considerations governing the choice of natural or induced draft, etc. In concluding the following subjects were given out to the class for report: Merits and demerits of mechanical stokers; brick stacks vs. steel stacks; jet surface condensers and the conditions governing their use; induced draft vs. natural draft; conditions under which horizontal or vertical engines should be used; merits and demerits of steam turbines for central stations; describe different methods of making joints in piping and of taking care of the expansion in piping. At the end of the lecture Prof. Barstow announced that his lecture on the "Electrical Plant," scheduled for January 17, would have to be postponed until January 23.

School of Applied Electricity.

On January 10 there will be opened at Boston under the auspices of the Young Men's Christian Association, a school of applied electricity, established for the purpose of teaching the theoretical and commercial applications of electricity in its varied forms. Through the generosity of several friends of the association an excellent laboratory equipment has been secured, and the necessary quarters have been obtained in the Park Square Automobile Station.

An advisory board will have direct control of the management and control of the school, consisting of Dr. Robert Amory, who has been for years identified with the gas and electric interests of Boston, and is at present a member of the educational committee of the association; Thomas C. Wales, chief engineer of the New England Telephone & Telegraph Company; Sidney B. Hosmer, superintendent of installation for the Edison Electric Illuminating Company, and a high official of the Boston Elevated Railway system. These gentlemen have secured as the president of the school Prof. William L. Puffer, of the Massachusetts Institute of Technology. Prof. Puffer has had a very broad experience in connection with the leading electrical scientific societies and with various insurance interests, and has been for sixteen years lecturer in electricity under the auspices of the Lowell Institute. Associated with Prof. Puffer are a board of competent men, all of whom are at present identified with technical schools or branches of the profession.

The course will consist, after this year, of a thirty-week term, the first ten weeks being devoted to a series of lectures by William Lincoln Smith, formerly of the Massachusetts Institute of Technology teaching staff, whose lectures will be fully illustrated, dealing with the theory of electricity and preparing for the laboratory course.

The laboratory work, hereafter, will consist of twenty weeks of instruction, the work being intended to explain and emphasize the theoretical presentation previously made. The following practical subjects will be thoroughly presented: Batteries, dynamos, motors, annunciators, telephone, telegraph, arc and incandescent lighting, wiring of all kinds, electrical measurements, the reading of instruments and practical applications of the above. Apparatus of large capacity has been secured and all of the laboratory equipment

is such as is in absolute commercial use. A catalogue fully describing the course has been prepared and may be obtained at the association office.

Recent Use of the Telephone.

In discussing recent aspects of telephone work, Mr. W. E. Curtis says: "The telephone has been remarkably useful as an implement of war in Manchuria. We used it in the Spanish war to a certain extent, and it was a great convenience in camp, but the Japanese have utilized it on the field of battle, and the men of their signal corps have stood again and again under fire with wires and instruments in their hands, ready to rush forward and string them up as the troops advanced in the face of the enemy, or in following the retreat. Foreign military observers say that several battles have been directed by telephone by the Japanese. The Russians may have used them also. The headquarters of Field Marshal Oyama have been connected by wire with the headquarters of every division and many brigades, regiments and batteries, and orders and reports are now given orally over the wire, instead of being sent by aid-de-camps and orderlies. One of the foreign attaches describes a general of a division in the midst of a battle, seated upon his horse with a transmitter in his hand, making a report to headquarters. He was compelled to fill his left ear with mud in order to hear the replies because of the rattle of musketry around him. The Japanese are farther advanced in the use of the telephone than any other nation except Sweden, and the United States probably comes third.

"William M. Capp, of Philadelphia, says that 'returning friends from Europe tell us that the telephone and telegraph service in the principal countries far exceeds in promptness and general efficiency the same service in the United States; that it is cheaper to the public, and managed in a more acceptable way; that the mail deliveries are far more numerous and prompt; that by pneumatic tubes a letter is transmitted and delivered in thirty minutes over such distances as from Berlin to Paris, and at only a small advance over ordinary postage rates.' It is true that the telegraph and mail facilities of the principal countries of Europe and Japan also excel those of the United States. We are far behind them in the promptness of delivery and efficiency of mails and in economy of telegraphing, but no country except Sweden and Japan have such perfect telephone facilities as the United States. It is also true, as Mr. Capp states, that in several European cities people can hear operas in their own drawing rooms over telephone wires. That has been a popular fad, but, at the same time, the ordinary daily service with the butcher, the baker, the groceryman, the liveryman and among the houses of friends in England, France, Germany, Italy and other countries, except Sweden, is nowhere near as good as in our own country. No American will try a third time to send a message over a German telephone. The first time he tries he will work himself up into such a state of exasperation that the lives of the telephone people are not safe; the second time he will drop the transmitter in disgust and despair, and the third time he will walk two miles to deliver the message or use a telegraph blank or a post card, which are much more satisfactory."

Telegraphing Bets Illegal.

According to an interesting decision by Judge Pitney, in the Supreme Court of New Jersey, the telegraphing of bets on horse races in that State, even into another State, is contrary to Sections 50 and 65 of the Crimes Act. The opinion was given in the case of Mark Ames, who was manager of the Old Dominion Telegraph Company, office at Atlantic City. Ames was charged with violation of the Crimes Act because of his having telegraphed a money order bet from Atlantic City to the Bennings race track. This act, Justice Pitney holds, constituted the keeping by Ames of a place where betting was done. The opinion is the outcome of habeas corpus proceedings instituted for the relief of Ames. The syllabus of Justice Pitney's opinion is as follows:

"Section 65 of the Crimes Act of 1898, which prohibits the keeping of a place within the State to which persons may resort for pool selling or bookmaking or for betting upon the event of any horse race, either within or without the State, or for gambling in any form, or aiding, abetting or assisting therein, is violated by the keeping of a resort for gamblers whose wages are made by means of telegraphic communication with persons outside the State, although the latter be not violating their own local laws in accepting such wagers. In order to constitute a violation of Section 65 it is not necessary that both parties to the betting transaction should be within the State. Secion 65 is not in conflict with the interstate commerce clause of the Federal Constitution, although the section may incidentally operate to prevent interstate wagers by telegraph."

Electricity and Automobilism.

In a communication to the *Manufacturers' Record*, on the subject of "Autobuses," or self-contained automobiles, Mr. Nikola Tesla advocates the use of electricity and says: "Steamers and trains are still being propelled by the direct application of steam power to shafts or axles. A much greater percentage of the heat energy of the fuel could be transformed in motive energy by using, in place of the adopted marine engines and locomotives, dynamos driven by specially-designed high-pressure steam or gas engines, by utilizing the electricity generated for the propulsion. A gain of 50 to 100 per cent. in the effective energy derived from the fuel could be secured in this manner. It is difficult to understand why a fact so plain and obvious is not receiving more attention from engineers.

"At first glance it may appear that to generate electricity by an engine and then apply the current to turn a wheel, instead of turning it by means of some mechanical connection with the engine, is a complicated and more or less wasteful process. But it is not so; on the contrary, the use of electricity in this manner secures great practical advantages. It is but a question of time when this idea will be extensively applied to railways and also to ocean liners, though in the latter case the conditions are not quite so favorable. How the railroad companies can persist in using the ordinary locomotive is a mystery. By providing an engine generating electricity and operating with the current motors under the cars a train can be propelled with greater speed and more economically. In France this has already been done by Heilmann, and although his machinery was not the best, the results he obtained were creditable and encouraging. I have calculated that a notable gain in speed and economy can also be secured in ocean liners, on which the improvement is particularly desirable for many reasons. It is very likely that in the near future oil will be adopted as fuel, and that will make the new method of propulsion all the more commendable. The electric manufacturing companies will scarcely be able to meet this new demand for generators and motors.

"In automobiles practically nothing has been done in this direction, and yet it would seem they offer the greatest opportunities for application of this principle. The question, however, is which motor to employ—the direct-current or my induction motor. The former has certain preferences as regards the starting and regulation, but the commutators and brushes are very objectionable on an automobile. In view of this I would advocate the use of the induction motor as an ideally simple machine which can never get out of order. The conditions are excellent, inasmuch as a very low frequency is practicable and more than three phases can be used. The regulation should offer little difficulty, and once an automobile on this nevel plan is produced its advantages will be readily appreciated."

New York Electrical Society.

The 247th meeting of the New York Electrical Society will be held in the lecture room of the American Institute, 19 West Forty-fourth Street, New York, Wednesday, January 18, at 8 p.m. Prof. W. S. Franklin, of Lehigh University, will lecture on "Electric Waves and the Reaction of Transmission Lines." The elementary physical theory of electric wave motion will be outlined, and the mechanical analogies carefully developed. The physics of wave distortion and of wave alternation will be popularly discussed and the methods for reducing wave distortion and wave alternation will be clearly and exhaustively explained.

The lecture will be illustrated by lantern slides and by several models, one of which gives a full representation of the distribution of electromotive force and of current along a 200-mile single-phase alternating-current power transmission line.

Efficiency of Human Energy.

Prof. Atwater, of Wesleyan University, has recently made some remarkable experiments with the view to determining the efficiency of the muscular energy developed by a man. According to the results of the investigation, as reported in a Boston paper, man power is placed at the head of the list of efficiencies of power-generating machines.

The method adopted by Prof. Atwater to carry out his investigations is thus described: "By the simple expedient of making the tire of the rear wheel of a stationary bicycle pass between two electro-magnets, which are connected with a dynamo, all of the energy transmitted to the pedals is converted into a current of electricity. This current can be measured, and thus it is ascertained exactly how much power is employed.

"The rider operates his wheel inside of a great box of wood lined with metal. He is not permitted to leave the box for several days and nights, and all of his food and drink is carefully weighed. In this way the amounts of fuel and water supplied to the human engine are accurately ascertained, and the total energy which they represent can be easily figured out.

"As a result of the experiments, it has been found that a man is a much better engine than a locomotive, yielding nearly twice as much power for a given amount of fuel. He is superior in this respect to the best and most economical pattern of automobile. In fact, no kind of engine as yet contrived—steam, gasoline or electric—is equal to him as a producer of energy.

"Prof. Atwater says that the most economical engine built to-day utilizes, in the shape of work, only 15 per cent. of the energy contained in the fuel supplied to it. The human power machine develops 20 per cent. without counting what is required to keep the internal mechanism of the body running. Of course, it takes considerable power to keep the heart pump going, and the digestive apparatus in operation. To reckon the expenditure for these and other functions at an additional 20 per cent. would not be over the mark.

"Thus it is seen that the human engine runs with much less waste than any mechanical contrivance yet devised. Man stands to-day the model machine, and, with all his vaunted ingenuity, he cannot construct an apparatus that comes near to equaling his own body as a work-producer. Nor, indeed, will any other kind of engine, though built of the best obtainable materials, run for anything like so long a period without wearing out, requiring in the same time so small an expenditure for repairs."

Trees in Wireless Telegraphy.

According to advices from San Francisco, after months of careful experiment, Major George O. Squier, of the United States Signal Corps, has discovered that trees may be used to catch wireless telegraph messages and to convey them to an observer standing on the ground. He has found that trees may serve the purpose of Marconi's metal feelers or antennæ, as they are called, and that tree trunks, while serving as masts or towers, also serve as wires to bring electro-magnetic currents to earth. The healthier the tree the better it serves as a conductor. For highly oscillating currents the leaves of trees or of plants behave precisely as if they were made of metal, and they will transmit these oscillations from the ground surrounding them through their leaves. At Fort Mason Major Squier attached his telegraphic apparatus to trees and communicated with the wireless station on Alcatraz Island, about two miles distant. He also communicated in this way between Goat and Alcatraz Islands, a distance of three miles and a half.

Major Squier claims great advantages for this system of tree telegraphy in army field operations. He experimented across San Francisco bay to determine to what extent electromagnetic oscillations of low frequency are absorbed by vegetation. He used the long-distance transmission line of the California Gas & Electric Company, bringing the electric power from Yuba County, clear across the State.

Two nails were driven into a tree and a telephone was placed in connection between them, the result being that the current flowing through the tree trunk was indicated with great clearness in the telephone. If plants are massed close together a heavy discharge will take place between the nearest leaves. Major Squier found the vegetation was stimulated by a moderate amount of electricity and killed by heavy shocks, the same as animals.

Growth of Bell Telephone.

The net instrument output of the American Telephone & Telegraph Company for the eleven months ending November 30, 1904, amounted to 628,660 instruments, nearly equaling the output for the entire twelve months of 1903 and exceeding that of any previous year. The growth of the Bell system since 1894 is shown in the following table:

	Instruments Outstanding.	Increase.	Per cent. Increase.
1894	583,506	16,015	2.8
1895	674,976	92,470	15.8
1896	772,627	97,651	14.4
1897	919,121	146,494	18.9
1898	1,124,846	205,725	22.3
1899	1,580,101	455,255	40.4
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7
1903	3,779,517	629,197	19.9
1904 (11 months)	4,408,177	628,660	16.6

The increase for the entire year 1904 is likely to be close to 700,000 instruments, which would be the largest year's output on record. A net output of 700,000 this year would indicate a gain of about 280,000 in the number of subscribers, the ratio of subscribers to instruments averaging about 40 per cent. The increase in the net earning capacity of American Telephone stock arising from the growth of the Bell system the past year may be figured by allowing for gross earnings per annum at the rate of $50 per subscriber, a fair average rate, and an operating ratio of 70 per cent. The increased earning capacity per annum on this basis is shown in the following table:

Increase in subscribers	280,000
Increase in gross earnings ($50 per subscriber)	$14,000,000
Increase in expenses (70% of gross)	9,800,000
Increase in net earning capacity all companys	4,200,000
Parent company's share (one-half)	2,100,000

In addition to this sum, the parent company will also receive an increase in rental of instruments, making the total increase in net earning capacity on the basis of last year's growth not less than $2,500,000. As against this sum, it will have additional charges of only $1,000,000, or 5 per cent. on the $20,000,000 notes issued for extensions. The balance of $1,500,000 increase in net earning capacity is equivalent to over 1 per cent. on the stock outstanding.

Electrical Engineers of the Times—II.

PUTNAM A. BATES.

Mr. Putnam Asbury Bates was born in New York City on December 27, 1875, and was educated in this city, passing from the Berkeley Military School to Columbia University, where he took up the electrical engineering course in 1893. He graduated in the spring of 1897 with the degree of Electrical Engineer. Owing to

PUTNAM A. BATES.

family bereavement, necessitating his absence during part of the term, he found it necessary to do the work of eight months in the course in some six weeks, but this did not interfere with his satisfactory standing in the class upon graduation. A thesis which he prepared on the effects of heat on insulating materials was made also the subject of a valuable paper presented at the Greenacre

meeting of the American Institute of Electrical Engineers and forms part of the *Transactions* of that body.

Upon leaving college Mr. Bates joined the forces of the Crocker-Wheeler Company as a draughtsman in 1897. In a few months he was put in charge of all the equipment work in the New York district, which included during his incumbency a wide range of opportunity, among the plants being the Guggenheim Refinery of the American Smelting & Refinery Company, the refining plant of the Balbachs at Newark, the printing office equipments of the Butterick and the New York Life Insurance Companies, the plant at the Grand Central Depot and the plants for the large dry goods buildings of Abraham & Straus and the O'Neill Company. Mr. Bates was then made engineer of the New York office and was elected to the position of assistant secretary of the company. Shortly afterward he became sales manager as well and was placed in charge of the entire selling organization. This important position he held from 1899 to 1904, during which period he visited every important city in the Union and had under submission the plans for some of the largest electric power plants in the world. Some of these required special care and attention, as well as a broad ability to deal with intricate engineering questions.

In 1904 Mr. Bates retired from the Crocker-Wheeler organization and established the firm of Bates & Neilson, consulting electrical engineers, taking the opportunity before he did so to make a trip all over Europe in order to make an intimate study of foreign electrical conditions. The new firm last week by vote of the United Engineering Committee was approved on recommendation of the architects as consulting electrical engineers for the new Engineers' Club to be erected under the Carnegie gift of $1,500,000 to engineering. The firm have also had in hand a large amount of investigation and reporting for leading financial firms in New York City, as well as transmission work in the middle west. They have also been retained for the new Quintard Iron Works in New York City and for some extensive work done by the A. R. Whitney, Jr., Construction Company.

Mr. Bates has been an associate member of the American Institute of Electrical Engineers since 1897. He is also a member of the New York Electrical Society, the University Club and the Engineers' Club. He is a member of the Alpha Delta Phi fraternity and the honorary scientific society of Tau Beta Pi. Mr. Bates is also a member and officer of the Columbia Alumni Association and of the Columbia Engineering Society, before which body he lectured last year on the "Control of Variable-Speed Motors."

In addition to his active participation in technical bodies and persistent devotion to professional duties, Mr. Bates has been very much interested in athletics, holding a number of cups won at polo and amateur steeple-chasing. He has been, since its formation, an enthusiastic member of the famous Squadron A, the first mounted body in the National Guard of the State of New York.

CURRENT NEWS AND NOTES.

BORROWING A CITY ELECTRICIAN.—According to a Chicago dispatch, Mr. Edward B. Ellicott, city electrician of Chicago, is to be loaned to New York to aid in the investigation by Controller Edward M. Grout into the cost of gas and electric light supplied to the city. Manhattan Island promises to be a rallying point for all the municipal lighting experts in the country at the present rate.

ALASKA TELEGRAPH PRESS RATES.—The Secretary of War has approved the recommendation of the chief signal officer of the army which reduces the press rates between Seattle and points in Alaska to half the present tariff. Cable rates will remain unchanged, but the land tariffs between stations in Alaska will be somewhat reduced at an early date.

THEORY OF THERMOELECTRIC ACTION.—We received too late for use in our issue of last week a note from Prof. Edwin H. Hall, sent to accompany the abstract in our columns of his A. A. A. S. paper entitled, "A Tentative Theory of Thermoelectric Action." The text of the note is as follows: "The theory here given is certainly incomplete and I fear that it may not be entirely self-consistent. It is intended to be suggestive rather than conclusive or exhaustive."

HOLYOKE MUNICIPAL LIGHTING.—The city of Holyoke, Mass., announces a reduction in the price of electricity from 25 cents to 12 cents per 1,000 watts, allowing in addition a discount of two cents per 1,000 watts on payments made before the 10th of the month. The minimum charge is 50 cents. The annual report of the Holyoke electric lighting plant owned by the city of Holyoke shows gross earnings for 1904, partly estimated, of $95,952 against 65,414, an increase of 46.6 per cent., while net earnings approximate $12,000 against a deficit of $12,000 for 1903. In making the reduction in electricity prices, the city clerk adds: "While the reduction will entail a decrease in receipts at first, the prospective new business during 1905 should nearly offset this loss." The city of Holyoke has operated a municipal gas and electric plant since 1902, representing an investment of $824,704. The city is paying its electrical department $100 per year for half arcs on overhead circuits.

UNITED ENGINEERING BUILDING.—At the meeting of the Conference Committee on the United Engineering Building, held January 7, Mr. Alfred R. Wolff was unanimously appointed consulting engineer for the heating and ventilation of both the United Engineering Building and the Engineers' Club to be erected at Thirty-ninth and Fortieth Streets under the Carnegie gift to engineering of $1,500,000. Mr. C. A. Mailloux was selected as the consulting electrical engineer for the United Engineering Building, and the firm of Bates & Neilson were selected as consulting electrical engineers for the Engineers' Club. All these gentlemen are well known in connection with the execution of large work of the class named in New York and vicinity, in addition to which they are prominently identified with the organization that will occupy the buldings in question. Mr. Wolff and Messrs. Bates and Neilson are also members of the Engineers' Club of some years standing, and Mr. Putnam A. Bates was for a long time district engineer for all the Crocker-Wheeler installations in the New York territory. A biographical sketch of Mr. Bates appears elsewhere in this issue.

PRESERVING TELEGRAPH POLES.—Experiments already made by the United States Forestry Bureau show conclusively that poles can be subjected to a preservative treatment which insures materially lengthened service. This treatment consists in impregnating the wood with antiseptics which prevent the growth of the fungi that cause decay. The treatment of telegraph and telephone poles, when attempted at all in this country, generally has been applied to the whole pole, requiring the use of air-tight cylinders 100 feet long or more. In these the poles are subjected to live steam for some time, when a vacuum is created. Creosote is then run in and pressure applied to force it into the wood. Yet for telegraph and telephone poles only about one foot of the entire length needs to be made immune from fungus. If this foot at the fatal ground line can be preserved from decay, the rest of the pole will take care of itself. Experiments are now to be made in treating the butts of the poles for a distance of about eight feet, thus carrying the antiseptics beyond the zone of decay attack. The creosote method will be used and dead oil of coal tar forced through the butt of the pole. American companies have made hitherto little use of preservative treatment.

SELF-STARTING SINGLE-PHASE INDUCTION MOTOR.—A patent issued December 27, 1904, to Mr. James H. Bryson relates to a method of constructing induction motors which are started as repulsion machines so as to secure a motor of large load capacity and yet one which requires but a small starting current. The secondary rotor member carries two electric circuits, both of which are on closed circuit when the machine is at normal operating speed and only one of which is in use when the rotor is accelerating as a repulsion motor. The repulsion motor winding is connected in the well-known way to the segments of a commutator upon which bear brushes placed on a locally closed circuit. The second winding of the armature is interspaced between the sections of the first one. Each section of this winding is connected by leads with contact plates against which and the commutator segments of the repulsion motor winding is clamped a ring of conducting material automatically by a centrifugally operated mechanism when the rotor has reached a certain predetermined speed. The repulsion motor winding can be designed for best starting conditions while the added winding can be so proportioned as to render the machine an excellent induction motor, without sacrifice of either starting or running qualities.

MR. CLOYD MARSHALL has been awarded a gold medal by the St. Louis Exposition in recognition of his efficient services to the exposition and as secretary of the electrical jury.

OPENINGS IN VENICE.—Mr. R. W. Bliss, United States Consul at Venice, in a report states that there is a large opening for electrical appliances in that city, as well as for good and cheap motor launches.

CHICAGO TUNNEL.—The Illinois Tunnel Company has bought land for $2,500,000 upon which, it is said, will be created the largest system of general warehouses in the country, to be operated in connection with the tunnel network, of which the automatic telephone service was the original neucleus.

HIGH POWER MARCONI WIRELESS STATION.—A dispatch from Rome, dated January 6, states that Marconi has signed a convention with the Government for the construction of an ultra-potent wireless station at Coltano, near Pisa, for communication with Poldhu, Cape Cod, and Cape Breton.

NIAGARA WATER AND POWER.—The proposition of the Niagara, Lockport & Ontario Power Company, in which New York capital is interested, and which has three New York directors, to supply Lockport with water from a power canal to be built from the Niagara River, has been carried by a popular vote of 2,860 to 328.

MUNICIPAL FEVER IN CHICAGO.—The Chicago City Council last week ordered Corporation Counsel Tolman to proceed at once with the drafting of a bill to be presented to the State Legislature as soon as possible, providing a method of acquiring municipal control and ownership of gas and electric plants. Chicago has already a municipal electric lighting plant.

THE AUTOMOBILE SHOW.—The fifth annual automobile show given under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers will be held at Madison Square Garden during the week of January 14 to 21. A most brilliant and successful show is assured, and every inch of space is occupied. Mr. James C. Young is the manager.

SUBMARINE CABLE HOUSE WRECKED.—The little wooden house which covered the landing place of the French submarine cable at East Orleans, Mass., near Cape Cod, was completely wrecked on January 7 by an unusually high tide and heavy sea, due in a certain degree to a southeast gale. The wreck interrupted the cable service for an hour or two, but a splice was made and business was resumed. The tide was the highest that has been experienced on Cape Cod for some years.

UNITED STATES AND CANADIAN WATER BOUNDARIES.—An International Commission will soon be examining the boundary waters between the United States and Canada. The two countries have agreed to the creation of a joint commission to formulate a report on boundary water disputes. The subjects which will be reported upon will be the St. John River, N. B.; the Richelieu and the St. Lawrence Rivers, Que.; the Great Lakes (particularly with reference to the Chicago drainage canal), the taking of power from Niagara Falls, the Hay channel and St. Mary's River at the Soo, and the diversion of waters tributary to the Lake of the Woods, and Lake Superior, near Duluth.

A NEW AUTOMOBILE JOURNAL.—The first number, dated December, has been issued of the *Automobile Builder,* of which Mr. Hayden Eames, well known from his connection with the Pope bicycle interests and the Westinghouse Electric Manufacturing Company, is publisher. The editor is Mr. Walter Wardrop, and the publication offices are in Cleveland, Ohio. The new journal is handsome in appearance, considerable thought having evidently been given to its artistic side. From the absence of an announcement of the scope of the publication, we judge that the publisher and editor have wisely concluded to allow the journal to "speak for itself," which it does in no uncertain tone, the contents being of a kind that fully bears out the claim implied in the title, that it is to be an organ of the automobile manufacturing interests. The first issue indicates that the important matters affecting these interests will be treated in a positive and comprehensive manner from a broad point of view.

TESTING WIRELESS TELEGRAPHY.—It is stated from Washington that the transmission of wireless telegrams will have an important part in the annual naval manœuvers in the Caribbean Sea, which will begin next month. Plans are being made for elaborate tests, and a majority of the vessels participating will be equipped with the wireless apparatus. Two or three different systems will be used and every effort will be made to intercept wireless messages and to break the lines of transmission. The vessels of the squadron will, as far as possible, be controlled by wireless telegraphy from the beginning of the manœuvers until the fleet comes north to Pensacola in March for target practice. Every effort will be made to test the efficiency of the instruments now used by the Government.

TELEPHONE OPERATORS' STRIKE IN PHILADELPHIA.—According to a Philadelphia dispatch, 150 telephone operators of the Keystone Telephone Company, went on strike January 7. The trouble was about the Saturday afternoon off. Announcement was made the day before that instead of getting off at 1 o'clock on Saturday afternoon the day forces at both the Main and Race Street exchanges would have to work late. Petitions were drawn up by the girls and committees appointed, but neither did any good. Then the strike idea formed. At 8.30 o'clock every girl in the two exchanges took off her headpiece and left her station. The managers pleaded and threatened. Down in the operators' room there was a notable illumination. On the long rows of switchboards the red lights, which are signals of persons making calls, flared by the hundreds, and the distracted manager could vividly picture the indignant patrons on the other end. At 9 o'clock the girls' claims were conceded and the strike declared off.

HOME LUNCHES.—New Yorkers think that the subway paid for itself in the recent bad snowstorms. The *Wall Street Journal* adds another reflection: "Not a few business men whose offices are in the lower part of the city and whose homes are in convenient reach of subway stations are beginning to indulge in the luxury of going home to lunch, thus avoiding the crush of downtown restaurants and securing the comforts of a few minutes' refreshment and rest in their own homes. It is not at all unlikely that this practice will grow, and when new lines of subways are built and bridges and tunnels that have been projected are constructed multitudes of men will be able, not only to reach their offices in the morning and their homes at night with greater convenience and speed, but will actually be able to take their noonday meals at home frequently and perhaps with regularity. In other words, the new means of rapid transit which have been developed and are about to be created will so unify this immense city of nearly four million inhabitants, and its suburbs containing a million more, as actually to give to its people many of the comforts enjoyed by citizens of small towns and cities."

CITY LIGHTING IN PARIS.—During last year the Paris municipality addressed some inquiries to certain prominent electrical authorities concerning the adoption of a settled electrical policy for the city. Many concessions for lighting granted by the municipality are approaching an end, having been granted for a limited term, and in view of the granting of future concessions for lighting, and also for traction, the need of a definite policy was strongly felt, and steps were necessary to ensure that the matter would not be dealt with from a niggardly standpoint. In addition, a technical commission has proceeded to the chief European and American centers to study lighting and transportation problems on the spot. The municipality addressed themselves to the following well-known European authorities, apparently overlooking French concerns, a fact which did not fail to provoke protests from representatives of the latter: Siemens-Schuckert Company, Brown-Boveri & Company, Allgemeine Elektricitäts-Gesellschaft, Prof. Eric Gerard and Prof. S. P. Thompson. Replies from some of these have now been published. That of the Allgemeine Elektricitäts-Gesellschaft includes a long detailed study of the existing conditions, and, among other things, proposes that a large central station, sufficient for all the present and immediate future needs of Paris, be established by the municipality, who should then control the sale of current for lighting, traction and power required within the boundaries.

A London Electric Railway Power House.

ABOUT two years ago work was commenced on the Lot's Road power house of the Underground Electric Railways Company, now completed, which is the largest of its kind in Great Britain, and supplies electrical energy to the entire District Railway, as well as to the Great Northern, Piccadilly & Brompton, the Baker Street & Waterloo, the Charing Cross, Euston & Hampstead and the Hampstead & Edgeware and Edgeware & Watford Railways. The permanent-way work, feeder system and sub-stations of the District Railway are about finished, while the work on the other railways is in various stages of advancement.

The generating station is situated in Lot's Road, Chelsea, and is bounded on one side by the Thames and on another by Chelsea Creek, which runs into the river at this point. Thus there will be entire independence of railways so far as coal supply is concerned. A special basin has been provided for the accommodation of barges.

FIG. 1.—GENERAL VIEW OF ENGINE ROOM AND SWITCHBOARD.

On the opposite side of the creek there is a branch of the West London Extension Railway, by means of which rail-borne coal can be delivered. The barge basin is spanned by a couple of huge traveling gantry cranes, each capable of dealing with one ton of coal at a time. After being weighed in one of the crane towers the coal is deposited on to a belt conveyor and raised to a height of 140 ft., at the top of one end of the building, by means of duplicate inclined elevators. Coal brought in by the railway is discharged into a hopper under the wagons and taken to the top of the other end of the boiler house by an inclined elevator. It will thus be seen that the bunkers can be fed from either end of the building, and for this purpose duplicate belt conveyors are installed, the direction of travel, in both cases, being reversible. No less than 15,000 tons of coal can be stored in the bunkers at the same time, and it is anticipated that about 800 tons per day will be required under normal working conditions.

When the station is complete there will be 80 Babcock & Wilcox boilers, each of which will be fitted with a chain grate stoker having 83 sq. ft. of heating surface. Each boiler has 5,212 sq. ft. of heating surface and 672 sq. ft. of superheating surface. At the present time 64 of these boilers are in position, these representing eight batteries of eight boilers per battery. American practice has been followed regarding the boilers, and this is the first station in this country in which they have been arranged on two floors. Eight boilers on one floor (four on each side of the gangway) form a battery. Directly opposite each battery of boilers is situated a generator set, each of which is supplied with steam by eight boilers; on the switchboard each generator panel is opposite its machine, and, in fact, the entire station, from feed pumps to feeder cables, is a striking example of the individual unit system now becoming standard practice. In the removal of ashes a departure from ordinary practice has been made. Owing to the enormous quantity of ashes which will be produced a special railway track has been laid under the boilers, and on this will run a small train of trucks hauled by a storage battery locomotive. The ashes from the boilers on both floors fall by gravity, through shoots, directly into trucks, which automatically dump their contents into barges after being raised by pneumatic hoists on the dock wall at the western end of the building. In the event of there being no barges empty the ashes may be deposited, for the time being, in an adjoining ashpit.

There are four Custodis chimneys, each having an internal diameter of 19 ft. at the base and a height of 275 ft. They are practically devoid of ornamentation, as is the building itself, which consists of steel framework filled in with terra cotta and bricks, the interior of the engine room being painted white. Fig. 1 is a plan of the engine room and boiler house, from which the arrangement of the economizers can be clearly seen. There are as many economizers as boilers, being situated behind the boilers, somewhere further apart than is usual. Each has 1,540 sq. ft. of heating surface, and the tubes are 10 ft. in length. All boiler feed pumps are steam- driven, and are situated on the ground floor. There is one feed pump for each group of boilers, and there is no steam connection between the various groups with the single exception that a supplemental header is provided at the east end of the boiler house for connecting the two end

groups. The function of this supplemental header is to supply the steam-driven auxiliaries, such as exciters, air compressors, etc.

The turbines are of the Westinghouse-Parsons four-stage parallel flow type. Each is coupled to a three-phase generator rated at 5,500 kw, and having an overload capacity of 50 per cent. for two hours at practically the same consumption of steam per kilowatt-hour.

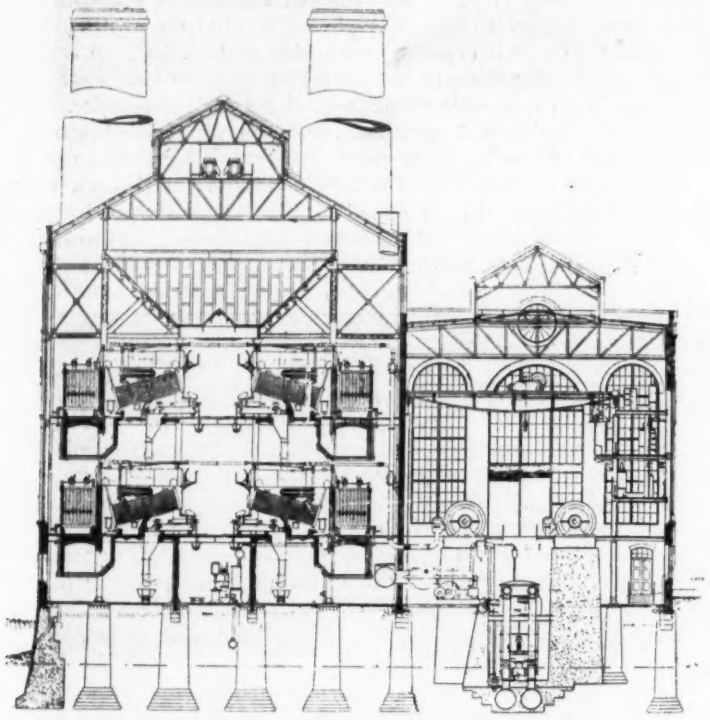


FIG. 2.—CROSS-SECTION OF ENGINE ROOM AND BOILER HOUSE.

When running at 1,000 r.p.m. these machines generate 11,000 volts at a frequency of 33⅓ cycles per second. One vertical surface condenser, having a cooling surface of 15,000 sq. ft., is provided for each generator, and, as may be seen from Fig. 1, the condensers are situated below the engine room floor between the turbine foundations. It may be remarked here that the greater portion of the engine room floor consists of removable plates, which facilitates the inspection and repair of plant situated in the basement. Circulating water is obtained from the Thames by means of a 66-in. pipe; as the outlet is at the same level as the inlet, the arrangement acts as a syphon, and it is merely necessary to overcome the friction of the pipes, which is effected by a 20-in. centrifugal pump to each condenser. At minimum low tide the tops of the condensers are within 29 ft. of water level, and it is possible to cause the circulating water to flow in either direction. The condensers work on the dry vacuum principle, separate air and water pumps being employed. Electric driving has been adopted for all condenser pumps.

The generators are excited by four 125-kw, 125-volt, direct-current dynamos, driven by reciprocating engines at a speed of 375 r.p.m. They are star-wound, and the neutral point is connected to earth through a resistance which limits the current going to earth to 1,000 amp. The negative excitation leads are connected directly from the exciters to the generator fields, by means of duplicate cables, which are carried in iron pipes on a rack underneath the engine room floor. These leads run the entire length of the engine room, and are tapped opposite each generator, the services being controlled by switches contained in iron boxes situated at the junctions. All regulators, meters and service switches are in the positive wire.

The switchboard is of the remote-control type, and occupies three galleries running the entire length (454 ft.) of the engine room. Opposite each generator set, on the engine room floor, is a cable uptake consisting of three compartments divided off by bricks. This extends from the engine room floor to the underside of the first gallery and carries in each of its compartments one of the generator cables. For he purpose of getting the cables from the generators to the bottom of the uptakes, earthenware pipes have been embedded in concrete laid between certain pairs of girders supporting the engine room floor. The cables are then drawn into these pipes and proceed direct to the switchboard, via the brick uptakes. Near the underside of the floor of the first gallery and in the uptakes are the current transformers, which are interposed between the generators and their oil switches. The cables are then carried through the first gallery floor by means of porcelain tubes to the generator motor-operated oil switches, which are capable of dealing with a current of 500 amp. On one side of each oil switch are built two brick chambers, one above the other, and on the other side is a third brick chamber. Each of these chambers accommodates a potential transformer, one being for each phase. These are star-connected on both the primary and secondary sides, and the neutral is earthed. They stand on asbestos composition trays, are oil-cooled and reduce the voltage from 11,000 to 110. Current from their secondaries is employed for working the generator wattmeters, voltmeters and reverse-current relays. The secondary leads themselves are carried to the various instruments in iron pipes buried in the concrete flooring of the gallery. The generator oil switches stand out toward the gallery hand rail, away from the cable panels, and the cables are taken from them to the panels by means of separate brick compartments on the floor. Porcelain insulators are fixed to the gallery floor and the cables are fastened to their tops, a stone slab covering all three compartments.

On reaching the panels the cables are supported vertically on triple petticoat insulators and pass upward through the floor to the second gallery. Before leaving the first gallery panels, however, each passes through an isolating knife switch, which is, of course, intended to be operated only when no energy is passing, although the terminals may be alive. The opening and closing of these switches is effected by means of a hook on the end of an insulating rod. The generator cable compartments are divided by artificial stone barriers 2 in. thick, the compartments themselves being 20 in. between centers. On the second gallery are the main bus-bars, also in three separate brick compartments, one above another and extending the entire length of the engine room. These bus-bars, like those on the third gallery, consist of three copper bars, measuring 2 in. by ¼ in., spaced ¼ in. apart, and supported at intervals by porcelain insulators. They are divided lengthwise into five sections, and between adjacent

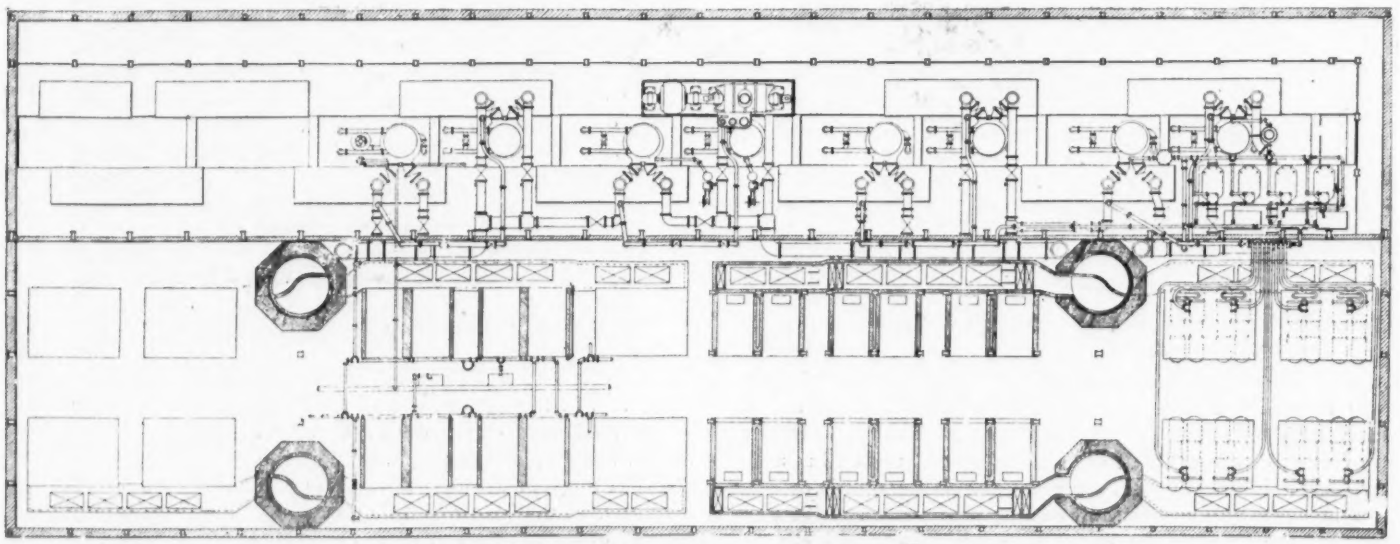


FIG. 3.—PLAN OF ENGINE ROOM AND BOILER HOUSE.

sections there is placed a 1,200-amp. motor-operated oil switch. Normally these four switches remain closed, and the five sections thus constitute one long bus-bar. To each section are connected the cables

FIG. 4.—MOTOR-OPERATED OIL SWITCHES.

from two generators, which come through the floor from the first gallery. The last section has, however, been designed for three generators. The generator cables, still kept apart by stone partitions, come up at the back of the bus-bars, and are attached to brass studs

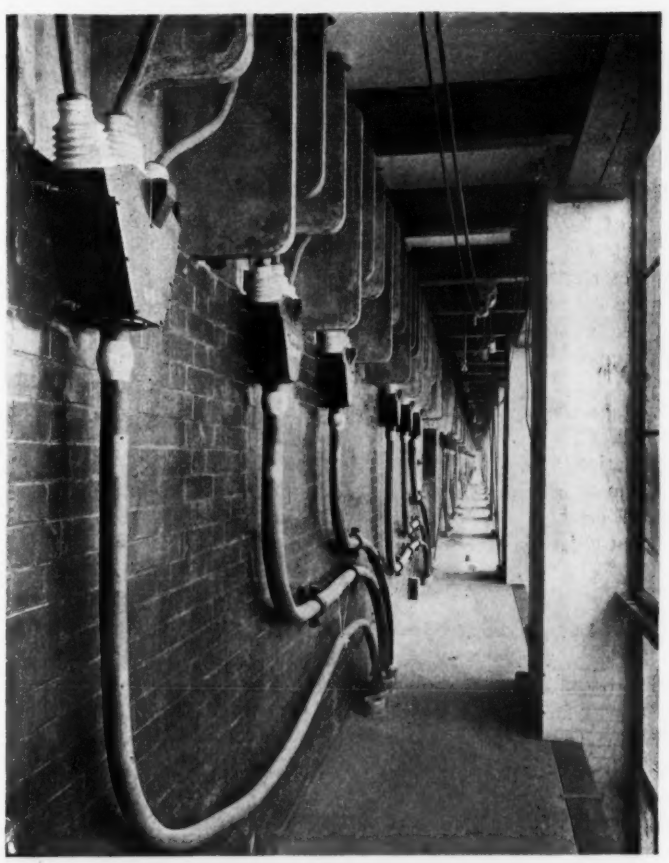


FIG. 5.—FEEDERS LEAVING THE BOARD.

which pass through insulators in the panels, and are then bolted to the bus-bars.

Thus, between the generators and the main bus-bars there are the following: Main generator oil switch, disconnecting knife switch and potential and current transformers. The function of the disconnecting knife switches is simply to allow of all gear on the generator side of the bus-bars being made dead so as to permit of cleaning and inspection. It has already been mentioned that the five bus-bar sec-

FIG. 6.—TRANSFORMERS FOR STATION LIGHTING AND AUXILIARIES.

tions are connected through motor-operated oil switches, but in order that these switches may also be attended to while the station is running, disconnecting knife switches are inserted in the cables on both sides of the oil switches. Cables have, of necessity, to be used

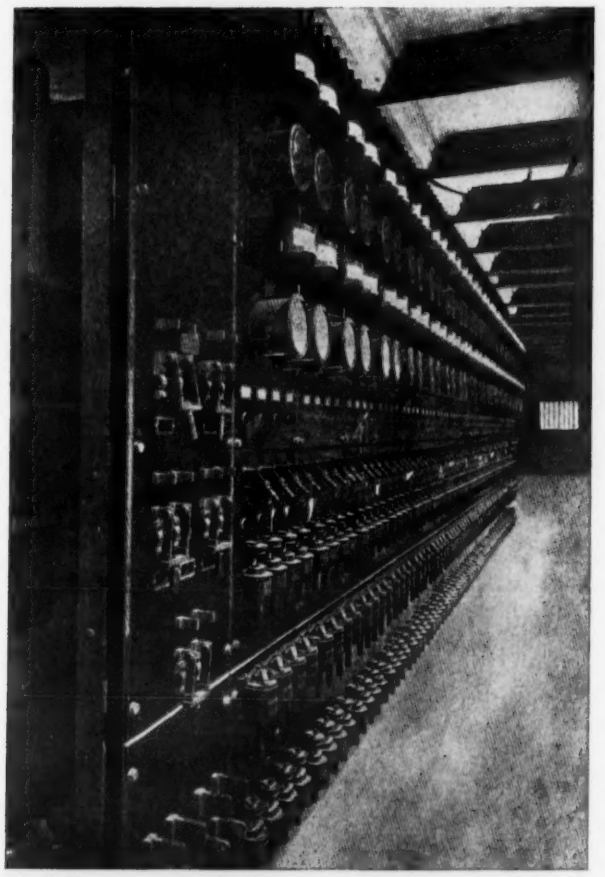


FIG. 7.—FEEDER CONTROL BOARD.

for making connections from the knife switches to the oil switches, and these are carried on insulators in separate brick compartments, under a false floor.

On the third gallery are the feeder bus-bars, also extending the

length of the engine room and housed in separate brick compartments; they are, in fact, almost a counterpart of the generator bus-bars. There is, however, one great difference, namely, their division into 10 instead of 5 sections. Bolted to the studs, which connect the generator cables to the main bus-bars, are other cables which proceed vertically through the floor above to motor-operated oil switches, each being capable of breaking a circuit carrying 1,200 amj. Knife disconnecting switches are inserted in the cables previous to their entering the oil switches. Two of these cables are connected to each section of the main bus-bar, and after passing through the oil switch each cable is connected to one section of the feeder bus-bar. The oil switches are termed "group switches," since each controls the six or seven feeders which are connected to its section of feeder bus-bars. There are, altogether, 68 feeders connected to the bus-bars, each being controlled by a motor-operated oil switch, which may also be isolated by a disconnecting knife switch on the bus-bar side. Fig. 5 gives an excellent idea of the appearance of the feeder oil switches. The stone slabs which are shown in the foreground are employed for covering the separate brick compartments in which the cables are run from the bus-bars to the switches. Of the 68 feeders, 65 are for operating the various lines of railway, while the remaining three supply three banks of transformers (Fig. 6), which reduce the voltage from 11,000 to 220 for the purpose of supplying low-tension, three-phase current for lighting and working certain of the electrically-driven auxiliaries in the station. There are three single-phase, 166⅔-kw transformers in each bank supplied by the Westinghouse Company. The high-tension cables are brought up to the transformers on insulators in a false floor, while the low-tension leads pass downward through the floor on the opposite side. The transformers themselves are air-cooled, the blast being created by means of electrically-driven fans.

The feeders pass from the oil switch terminals at the back of the board on the third gallery, through the floor to the second gallery, where they still continue as three separate cables and where the current transformers are interposed. After passing through the floor of the second gallery each of the three cables forming one feeder is attached to the terminals of two knife-disconnecting switches in such a manner that the lightning arrester may still be left connected to the feeder even when the latter is not being fed from the generating station. On the other hand, when it is desired to clean or inspect the arrester, this operation may be effected while the feeder is in service, by pulling out one of the disconnecting switches. The cables are then brought into three-way dividing bells, from which each feeder emerges as a three-core, lead-covered cable. All these cables are cleated to the wall and then taken through the floor to the conduit, and so to the sub-stations. All cables within the station, except those which have been specifically mentioned as being lead-covered, are rubber-covered and asbestos insulated.

Fig. 8 shows the generator control board, which is of the bench type and is mounted in a bay of the second gallery, facing the engine room. The instruments are on a level with the operator's eye and the switches are all situated so as to be manipulated with the greatest ease. In each phase there is an ammeter, while each generator is provided with one indicating and one recording polyphase wattmeter, a power factor indicator, a voltmeter and a field ammeter. Synchronizers of the dial type are mounted on swinging brackets at both ends of the board. Each panel, so far as instruments are concerned, is in exact duplicate of every other panel, but there is a certain amount of difference with regard to the switches. Altogether, there are 11 panels on the operating board, and, apart from the instruments mentioned above, the following are common to all: One control switch for each generator oil switch, one for each group switch, one for each motor-operated generator field rheostat, one control switch for each motor-operated turbine governor, one push button for signaling to the driver and one synchronizing receptacle. Since the main bus-bars are divided into five sections by four switches, only four control switches are required, and these have been placed on panels 2, 4, 6 and 8, while the corresponding synchronizing receptacles for the bus-bar sections are on panels 1, 3, 5 and 7. In addition to the above, there is a field switch of the knife-blade pattern on each panel. All the control leads are carried in iron pipes buried in concrete, and the circuits are operated from a battery at 110 volts, which is the same potential as that used in the instrument circuits.

The feeder control board consists of 18 panels, 17 of which are equipped with feeder instruments and switches, while the eighteenth is set apart solely for the control battery. Each of the 17 feeder panels carries an ammeter and a wattmeter, with an overload relay in each phase and a control switch for operating the oil switch. All control switches, both on the generator and feeder boards, are accompanied by colored signal lamps, which indicate whether the main switch is open or closed.

For controlling the electrically-operated auxiliaries and the station lighting there is an auxiliary board consisting of 24 panels. Of these four are exciter panels, each carrying a single-pole switch. There is also one panel for a motor-generator, whose function it is to charge the battery. The high-tension oil switches for the station transformers are operated from this board, and the low-tension switches are of the automatic oil-break type. There is nothing of special interest with regard to this switchboard with the exception that the low-tension alternating bus-bars have been sectioned up in such a manner that at times of light load all repairs and inspection may be carried out without the necessity of working on live metal.

The feeders, after leaving the switchboard, are led into a conduit

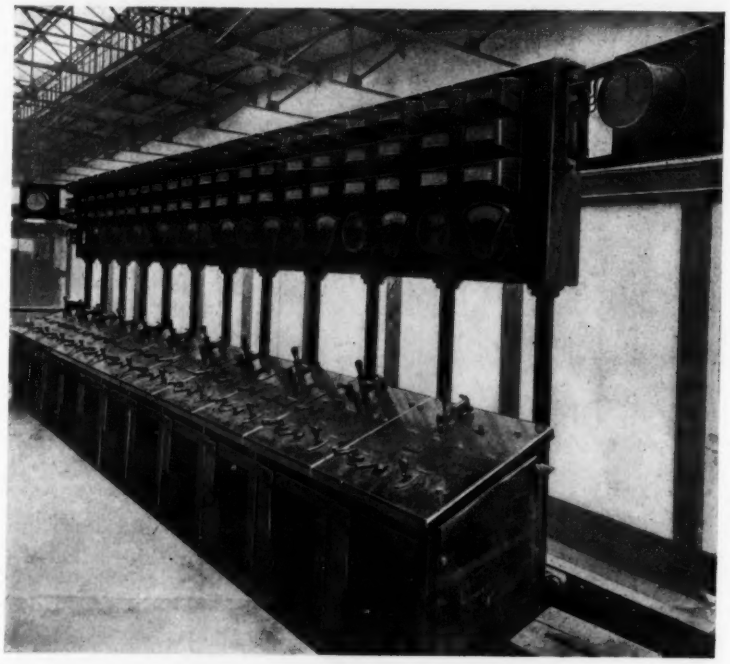


FIG. 8.—GENERATOR CONTROL BOARD.

which runs from the generating station to Earl's Court. This conduit consists of 64 pipes embedded in concrete, 32 being one side of a 9-in. brick wall and 32 on the other. Every feeder is in duplicate, the spares all being laid on one side of the brick wall, which runs the entire distance. Three-core, paper-insulated, lead-covered cables of 0.15 sq. in. section are employed in the conduit, but wire-armored cables, supported by brackets, are used along the railway line. After the cables were laid, tests were made at a pressure of 22,000 volts. This voltage was applied between conductors and between conductors and earth.

The station was constructed under the supervision of Mr. James R. Chapman, general manager and chief engineer to the Underground Electric Railways Company, of London. Mr. J. W. Towle is resident engineer at Lot's Road.

Deterioration of Underground Cables.

In a letter in our London contemporary, the *Electrical Times,* Mr. James Perry states that in his experience when lead-covered cables are laid in sand moistened with coal tar, there is no deterioration of the sheath, while the opposite is the case with cables laid in solid bitumen. He ascribes this difference to the fact that the tarred sand compresses firmly about the sheath, thereby excluding air and moisture, whereas the bitumen does not adhere to the lead and tends to crack under vibrating shocks, thus giving passage to air and moisture. Cables laid about 15 years ago, according to the first-mentioned system, have given no trouble whatever, whereas lead-covered cables laid in solid bitumen have given much trouble. It is probable that a crack once started in bitumen reopens repeatedly, with the result that the lead sheathing at the bottom in time also develops a crack.

Commutation at Starting of Alternating-Current Motors with Commutator.

BY MARIUS LATOUR.

IN a preceding article I have set forth the considerations relating to the commutation at starting of the single-phase motor without resistance leads between the armature and the commutator. I have shown that the best conditions are represented by the following formula:

$$s = \frac{4\,af}{t\,q} \cdot P,$$

$$l = \frac{4\,f}{t\,q} \cdot P,$$

$$p = \frac{4\,af}{t} \cdot P,$$

$$p_1 = 0.08\,\frac{n\,af}{q} \cdot P,$$

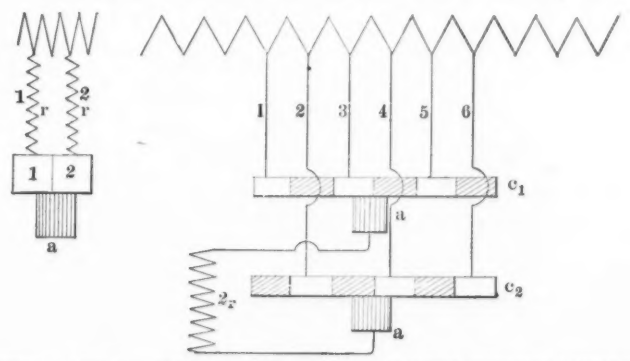
in which s represents the commutator rubbing surface expressed in square centimeters;
a the width of the brushes in centimeters;
l the total length in centimeters of all lines of brushes;
f the frequency of the supplied current;
t the peripheral speed of the commutator in centimeters per second;
q the power expressed in watts liberated per square centimeter of brush area at starting;
P the capacity of the motor;
p_1 the power representing the friction losses on the commutator at full speed.

The formulas were established under the assumption that the brushes cover two bars.

The application of these formulæ to a 100-hp motor, the commutator bars of which are 4.5 mm. wide, gave the following results for a commutation corresponding to $q = 25$ watts:

$$l = 1.50 \text{ m.},$$
$$p = 3.375 \text{ kw.},$$
$$p_1 = 2.150 \text{ kw.}$$

The length, $l = 1.5$ m., can be realized in a six-pole straight series motor with six lines of brushes of 25 cm., and in a four-pole repul-



FIGS. 1 AND 2.—COMMUTATION OF ALTERNATING-CURRENT MOTORS.

sion motor with eight lines of brushes of 18.75 cm. by using two short-circuits (see my article in *Elektrotechnische Zeitschrift*, Nov. 10, 1904).

The application of the same formulæ to a 200-hp motor gives the following results:

$$l = 2.40 \text{ m.},$$
$$p = 6.750 \text{ kw.},$$
$$p_1 = 4.320 \text{ kw.}$$

For networks it would be possible to build a motor of any capacity by increasing the number of poles. (In this case the only motors that may be used with advantage are the repulsion motor or the compensated motor of my type). But a traction motor with 2.40 m. of brushes would have no practical meaning.

A special construction for commutator armatures was proposed by Edison and Marcel Deprez many years ago, in which resistance leads are used between the winding and the commutator. It is this arrangement that I have the intention to discuss here in connection with the starting of the single-phase motor.

Let us assume that the rotor of an alternating-current motor has resistance leads (Lamme motor). Let us consider the case when the bars of the commutator are as wide as the brushes. Let us call (see Fig. 1):

s_1 the contact surface between the brush and the bar 1;
$s_2 = s - s_1$ the contact surface between the brush and the bar 2;
ρ the contact resistance per square centimeter;
r the resistance of the leads.

The current, I, introduced through the brush, is divided in the following manner:

Conductor 1:

$$I \cdot \frac{\frac{\rho}{s_2} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r}.$$

Conductor 2:

$$I \cdot \frac{\frac{\rho}{s_1} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r}.$$

The power liberated under the contact surface is equal to:

$$I^2 \left[\frac{\frac{\rho}{s_2} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \frac{\rho}{s_1} + I^2 \left[\frac{\frac{\rho}{s_1} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \cdot \frac{\rho}{s_2}$$

The power liberated in the resistance connections is:

$$I^2 \left[\left[\frac{\frac{\rho}{s_2} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 + \left[\frac{\frac{\rho}{s_1} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \right] r$$

The average power liberated at the commutator is:

$$I^2 \frac{1}{s} \int_0^s \left[\frac{\frac{\rho}{s_2} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \frac{\rho}{s_1} + \left[\frac{\frac{\rho}{s_1} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \frac{\rho}{s_2}\, ds_1 \quad (1)$$

The average power liberated in the resistance connections is:

$$I^2 \frac{1}{s} \int_0^s \left[\left[\frac{\frac{\rho}{s_2} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 + \left[\frac{\frac{\rho}{s_1} + r}{\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r} \right]^2 \right] r\, ds_1$$

The short-circuit current, I_1, has the value:

$$\frac{v}{\frac{\rho}{s_1} + \frac{\rho}{s^2} + 2r}.$$

The power liberated at the commutator is:

$$\frac{v^2 \left(\frac{\rho}{s_1} + \frac{\rho}{s_2} \right)}{\left(\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r \right)^2}$$

The power liberated in the resistance leads is:

$$\frac{v^2 \cdot 2r}{\left(\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r\right)^2}$$

The average power liberated at the commutator by the short-circuit current, I_1, is:

$$\frac{1}{s}\int_0^s \frac{v^2\left(\frac{\rho}{s_1} + \frac{\rho}{s_2}\right)}{\left(\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r\right)}\, ds_1 \qquad (2)$$

The average power liberated in the resistance leads by the short-circuit, I_1, is:

$$\frac{1}{s}\int_0^s \frac{v^2 \cdot 2r}{\left(\frac{\rho}{s_1} + \frac{\rho}{s_2} + 2r\right)}$$

To calculate the integrals (1) and (2) I take as variable $\frac{s_1}{s} = x$, and I put $\frac{\rho}{s} \cdot \frac{1}{r} = a$.

The calculation, which is rather long and complicated, gives the following results:

The power, p_1, liberated at the commutator by the exterior cur- is equal to:

$$p_1 = I^2 \frac{\rho}{s}\frac{1}{2}\left[\frac{1+3a}{\sqrt{1+2a}} \cdot Log\frac{1+\sqrt{1+2a}}{-1+\sqrt{1+2a}} - 1\right] = I^2 \frac{\rho}{s} \cdot \frac{1}{2} \cdot \rho_1(a)$$

The power, p_{I_1}, liberated at the commutator by the short-circuit current is equal to:

$$p_{I_1} = \frac{v^2}{\frac{\rho}{s}} \cdot \frac{1}{2} \cdot \frac{a^2}{1+2a} \cdot \left[\frac{1+a}{\sqrt{1+2a}} Log \frac{1+\sqrt{1+2a}}{-1+\sqrt{1+2a}} - 1\right] = \frac{v^2}{\frac{\rho}{s}} \cdot \frac{1}{2} \cdot a_2(a)$$

According to an equation that I gave in my previous article, we have:

$$vI = \frac{\pi\, af}{t} \cdot P \cdot$$

It follows that the losses at the commutator remain a minimum when the losses due to the short-circuit current, I_1, are equal to the losses due to the exterior current, I. By proceeding as in the preceding article, we find for the best value of s, l, p:

$$s = \frac{2\pi\, af}{tq} \cdot \sqrt{a_1(a)\, a_2(a)} \cdot P$$

$$l = \frac{2\pi\, f}{tq} \cdot \sqrt{a_1(a)\, a_2(a)} \cdot P$$

$$p = \frac{2\pi\, f}{tq} \cdot \sqrt{a_1(a)\, a_2(a)} \cdot P$$

The corresponding value of v is:

$$v = \sqrt{\frac{\rho q}{a_2(a)}}$$

Let us assume that $a = 0.2$, which means that the resistance of one lead corresponds to five times the contact resistance of a single line of brushes. We then have:

$$a_1(a) = 2.34$$
$$a_2(a) = 0.043$$
$$\sqrt{a_1(a)\, a_2(a)} = 0.32$$
$$2\pi\sqrt{a_1(a)\, a_2(a)} = 2.$$

In this case the best values of s, l, p are as follows:

$$s = \frac{2\,af}{t\,q} \cdot P$$

$$l = \frac{2\,f}{t\,q} \cdot P$$

$$p = \frac{2\,f}{t\,q} \cdot P.$$

We find for l, s and p values half as large as in the previous article. However, we use bars twice wider. The efficacy of resistance leads is thus demonstrated.

But with resistance leads there is difficulty in properly locating and ventilating them. Besides, if they have a good effect at starting, they cause some trouble in the commutation at full speed and decrease the efficiency.

M. Marcel Deprez indicated in 1888 the following arrangement for Gramme continuous-current machines (see *Lumiere Electrique*, Vol. XLIII, page 557). The commutator of the Gramme armature is made up of two commutators (see Fig. 2). The armature having an even number of coils, the uneven bars, 1, 3, 5, 7, are on a first commutator, C_1, and the even bars, 2, 4, 6, are on a second commutator, C_2. The omitted bars on every commutator are replaced by an equal space of insulation. One brush, A, is disposed on every commutator along the same straight line.

If now the two brushes, $A\,A$, are connected together with a resistant, $2r$, and if the current led to the armature is introduced at the middle of this resistance, it may be easily seen that the operation of the armature, from the point of view of the commutation, is quite the same as if resistance leads having a resistance, r, were used. By making the resistance, $2r$, equal to o, we would have the normal commutation without resistance leads.

The arrangement of the commutators in the way described is very difficult in practice. In reality the connections to the second commutator have to pass through the first commutator if the second commutator is at the side of the first one. If the second commutator is on the opposite side of the armature, the connections must go between the shaft and the armature and this can only be done with Gramme armatures.

I have found some arrangements with drum windings which give the same results.[1]

First, Arrangement with Series Windings.—If, in the case of an armature having a drum series winding we reduce the bars to one-half, so that we can dispose of as many dead bars as live bars, and if the brushes have only the width of one bar (see commutator *I*, of Fig. 3), there can only exist exterior short-circuits between the brushes of the same polarity. The short-circuit current may then be reduced by exterior resistances, r. In order to get, at full speed, a commutation corresponding to a double number of bars, I use a second commutator, *II*, on the opposite side of the armature.

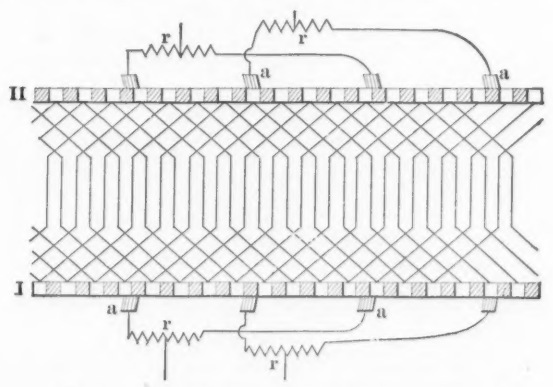


FIG. 3.—ARRANGEMENT WITH SERIES WINDING.

[1]See my French patent of June 27, 1903, "Résistance de démarrage pour moteurs à collecteur."

Second: Arrangement with Parallel Windings.—If a parallel winding is wound with two commutators (see Fig. 4) on each side of the armature and having as many dead bars as live bars, and if we utilize brushes not wider than one bar, we have only short-circuits outside of the armature. The short-circuit current may then be reduced with exterior resistances = *r*.

To treat these arrangements mathematically, we would have to use for *q* a value twice larger than in the case of Fig. 1. As a matter

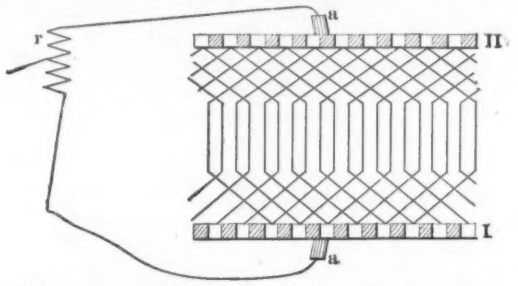


FIG. 4.—ARRANGEMENT WITH PARALLEL WINDING.

of fact, every brush works only half the time. But as we must have twice more brushes the total length remains the same, as in the case of Fig. 1.

Numerical Example:

$a = 9$ mm.,
$f = 25$,
$t = 20$ meters,
$q = 25$ watts,
$P = 150{,}000$ watts (corresponding to a 200-hp motor, as defined in my last article).

We find:

$s = 135$ cm.,
$l = 1.50$ m.

By using two commutators the length, 1.50 meters, would be obtained in a six-pole straight series motor with six lines of brushes of 12.5 cm. on each commutator and in a four-pole repulsion motor with eight lines of brushes on each commutator of 9.4 cm. The resistances, *r*, would be short-circuited automatically at full speed.

Instead of using resistances it would be, of course, possible to use self-induction coils so that the efficiency would not be decreased.

A Comparison of Alternating-Current Railway Systems.

BY J. H. HALLBERG.

THE application of electricity as motive power to replace steam locomotives for heavy traction may be considered one of the leading questions of the day. During the past five years much work has been done in this direction and the new system and locomotives to be installed for the New York Central Railroad represents the largest undertaking of this kind, although this system is only applicable to short distances, where the traffic is extremely dense and where trains are operated at frequent intervals.

While it has been the desire of railway engineers and operators to find a system of electric traction which could replace the steam locomotive for trunk line service, the manufacturers of electric locomotives have not as yet presented apparatus which can be considered safe and practically satisfactory.

The electric power equipment for a trunk line railway system consists broadly of three distinct elements: (*a*) The power station, (*b*) the distributing system, (*c*) the locomotives.

An electric railway system complying with the following general specifications would probably meet with the approval of practically all railway managers and engineers.

(*a*) The power station should supply high-voltage, single or three-phase current to the distribution system. For long-distance work and where the trains are not operated very close together the generators should preferably be of the single-phase type.

(*b*) The distribution system, consisting of the transmission wires and cables, and the contact conductors for the locomotives, must be simple, reliable and comparatively cheap to install and maintain. Some form of protected overhead contact conductor located on the side of the track is preferable to a conductor over the center of the track or to the use of the third rail construction.

(*c*) The electric locomotive for heavy trunk line railway service has not yet been developed, and the following sets forth some of the requirements which electric locomotive builders may have to meet:

(1) The locomotive should be adapted to receive high-voltage, single-phase, alternating current wherever permissible, and low-voltage, single or polyphase alternating current when necessary.

(2) The locomotive should be of a type which will return energy to the primary distribution system when the train is coasting, and

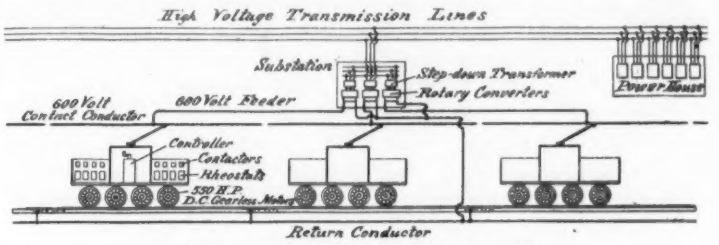


FIG. 1.—NEW YORK CENTRAL SYSTEM.

when it is desired to reduce the speed, without introducing special complicated switching and controlling apparatus for the purpose.

(3) The primary and the main current for the motors should not be directly controlled by automatic switches, controllers and rheostats; in fact, the main circuits should not be opened or closed under load.

(4) The electric equipment on the locomotive should permit the starting and operating of the train without introducing lagging currents and consequent disturbances in the primary distribution system.

(5) The application of power to the drivers should preferably be uniform and not in steps, so as to prevent skidding of the drivers.

(6) The operator of the locomotive should be able to increase the power on the driving motors about 100 per cent. without injury to the electric equipment, when the train has to climb a grade or when it has to cut through snow.

(7) The driving motors should not have commutators and brushes.

(8) The driving motors should, preferably, be gearless.

(9) Each driving motor should at all times be an absolutely independent unit, so that the failure of one motor will not prevent the use of the other motors for starting and operating the train.

(10) In case of an emergency the locomotive should be able to operate on a track 12 to 24 in. under water, without injury to the motors.

(11) Locomotives for heavy trunk line service should weigh anywhere from 100 to 200 tons with practically all of this weight on the drivers and should be capable of developing from 2,000 to 4,000 hp.

(12) Considering the power applied at the generators in the power station and the power delivered at the drivers on the locomotive, the efficiency of the entire electric equipment and distribution system should not be far from 65 per cent.

There are four different systems and types of locomotives which have been subject to many papers, editorials and discussions.

System 1.—The polyphase alternating-current, high-voltage transmission system in conjunction with the direct-current, low-voltage distribution system, with sub-stations and direct-current locomotives.

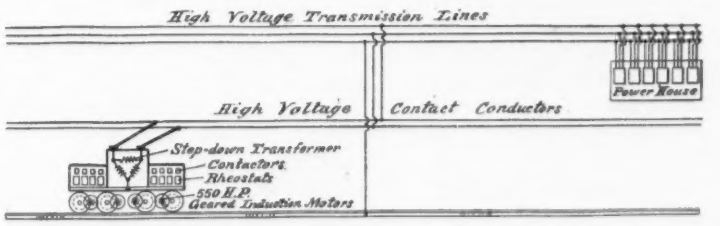


FIG. 2.—THREE-PHASE SYSTEM.

duction motors. This system is in practical operation in Europe (see Fig. 2).

System 3.—The polyphase or single-phase, alternating-current, high-voltage transmission system in conjunction with high or low-voltage, single-phase distribution system and high or low-voltage, This system is now being installed for the New York Central Railroad (see Fig. 1).

System 2.—The three-phase alternating-current, high-voltage transmission system in conjunction with high-voltage, three-phase distribution system and high-voltage locomotives with three-phase in-

single-phase locomotives, equipped with single-phase, alternating-

current, commutator type motors geared to the axles. This system has not been tried on a large scale (see Fig. 3).

System 4.—The single-phase, alternating-current, high-voltage transmission system in conjunction with high or low-voltage, single-phase distribution system and locomotives equipped with motor-generator sets, which receive high or low-voltage, single-phase, alternating current and deliver direct current at variable voltage to the driving motors, which may be of any suitable direct-current type. This system is in practical operation in Europe (see Fig. 4).

Attention is herewith called, for the first time, to an entirely new alternating-current railway system, which is distinct in that it does not require commutators, brushes, automatic contactors and rheostats for any of the main generating, transforming and driving machines, and makes use of long-tried apparatus, which are combined to secure the most practical and efficient results for heavy trunk line railway service (see Figs. 5 and 6).

The advantages and disadvantages of each system referred to may be better understood by referring to the following description

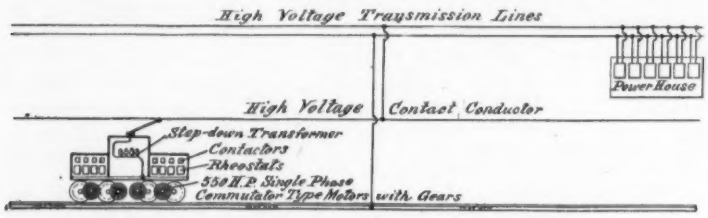


FIG. 3.—POLYPHASE OR SINGLE-PHASE SYSTEM.

and explanation, used in connection with the accompanying illustrations.

Fig. 1 illustrates, in diagrammatical form, system No. 1. Referring to the drawing, it will be seen that this system requires three high-tension and at least two low-tension wires the entire length of the railway.

Sub-stations must be erected and maintained about five miles apart along the railway. In each sub-station will be located the usual complement of switchboards, protecting devices, step-down transformers and rotary converters of approximately 2,000 kw capacity for each locomotive and trains.

Three railway sections are shown and each section is supplied with power from one 2,000-kw rotary converter, which practically limits each section to the starting current required for one locomotive.

It is probably not practicable to build rotary converters of larger capacity than 2,000 kw; therefore, each sub-station will have to be provided with one rotary converter and step-down transformer for each large locomotive, which may be supplied with power therefrom.

The failure of one sub-station from damaged primary wires, fire or other cause may seriously interfere with the operation of trains on several miles of track, and it may be difficult, if not impossible, to promptly supply power to the dead sections,

The above may not apply to the New York Central system, where the distance considered is short and sub-stations are very close together, and where the system is constantly inspected and repairs can be made promptly, but would have to be considered if this system should be used for trunk line service.

The locomotive for this system operates at about 600 volts. At this voltage a 2,000-hp locomotive would have to collect through sliding contacts at a speed of 65 miles per hour—not less than 3,000 amp., which may be difficult in the open country, under certain weather conditions.

With this system it is necessary to close and open the main circuit, which supplies power to the driving motors under full load, and sometimes under overload. On account of the large amount of current to be handled, the switches or contactors are subject to severe arcing, and they will consequently require considerable attention and repair.

The motors for this locomotive are of new design, with the armatures and commutators mounted directly on the driving axles.

The air-gap between armature and fields is about ¾ in. and the fields are movable relative to the armatures. Taking these facts and the fact that the armatures, commutators, brush holders and brushes are constantly vibrating, into account, it seems hard to realize good commutation and service from these motors on a track less perfect than that of the New York Central Company.

The failure of one motor may reduce the speed of the train to a considerable extent, by reason of the fact that commutator type motors may not be forced much above their normal rating for any length of time.

However, if the expectations of the designers and engineers, who have developed this locomotive, are realized in practice and the upkeep of this system does not prove to be excessive, it may be applicable to trunk line service, where the distance considered is not too great and the trains run very close together, and have to be started and stopped at frequent intervals, which necessitates rapid acceleration. The cost of the distribution equipment for this system is necessarily very large; therefore, and for other reasons understood by those familiar with the subject, this system is not applicable to trunk line railways in general.

Fig. 2 illustrates in diagrammatical form system No. 2. Referring to the drawing it will be seen that this system requires three high-tension transmission wires and two high-tension contact conductors along the entire railway, and each locomotive has to be provided with at least two contact devices for collecting current from the trolley or contact conductors.

On the locomotive is located a step-down transformer, which receives the primary high voltage which is then transformed to lower voltages suitable for the three-phase induction motors, which may preferably be geared to the axles.

The usual equipment of conductors, rheostats and other controlling devices will be required on this locomotive, but it is not always necessary to place the controlling devices in the main motor circuits, but they may be connected in the secondary circuits of the motors, which somewhat reduces the complications and the liabilities of trouble.

While this system has been entirely satisfactory in Europe, where small locomotives not exceeding 1,000 hp each are required for short distances, it would not be practical with 2,000 to 4,000-hp locomotives, inasmuch as the large lagging currents which are always present when induction motors are started would seriously interfere with the regulation of the primary distribution system, which may prevent proper operation of other trains on the system.

In order to reduce the lagging currents as much as possible, the air-gap between the stator and the rotary member of the induction motors has to be comparatively small; therefore, the induction motor is somewhat at a disadvantage in this respect if used in connection with a static transformer connected directly to the primary system.

The necessity of two contact conductors along the entire length of the railway and two contact devices on each locomotive practically prohibits the use of this system for long distances.

Fig. 3 illustrates in diagrammatical form system No. 3. Referring to the drawing, it will be seen that only two high-voltage transmission wires and one high-voltage contact conductor will be required along the railway, and each locomotive is provided with only one contact device. A step-down transformer may be located on the locomotive, which will transform the primary into a lower secondary

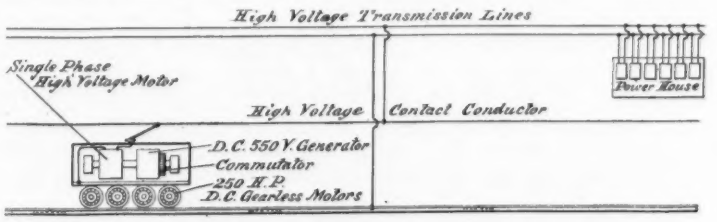


FIG. 4.—SINGLE-PHASE, ALTERNATING-CURRENT SYSTEM.

voltage, suitable for series-wound commutator-type motors, which may have to be geared to the axles. With these motors are required the necessary rheostats, controllers, switches, etc., which are also common to the standard direct-current railway motor, unless auto-transformers, inductive regulators, or similar devices which are fully as complicated, are used.

The single-phase, commutator-type alternating-current motor has not been put into practical service in large units and the effect of starting a locomotive equipped with 2,000 to 4,000-hp motors of this type directly from a primary distributing system is yet to be determined.

The capacity of the transmission wires and the contact conductors and the number of feeders for this system will probably have to be greater than for any other single-phase system in view of the comparatively low power factor of the motors at starting.

The air-gap between the armature and the fields of this motor

should be as small as possible, in order to maintain a high power factor, which is another disadvantage of this type of motor.

Compared with the polyphase motors, the weight and dimensions of the single-phase motor will be considerably greater, and the efficiency of the series commutator type motor is comparatively low, especially when it has to be geared to the driving axles. In view of the above it is doubtful if large electric locomotives, as referred to, can be equipped with single-phase commutator-type motors for trunk line railway service.

Fig. 4 illustrates in diagrammatical form system No. 4. Referring to the drawing, it will be seen that the distribution system is practically the same as that described for system No. 3.

The contact device collects high-voltage current, which is used for operating a single-phase synchronous motor, which drives a direct-current generator on the locomotive. The direct-current generator is under the control of the operator, permitting the application of any desired voltage on the driving motors, which may be of any direct-current type, suitable for the purpose.

There are many advantages in having a motor-generator set mounted on the locomotive, and it permits absolute control of the current for the driving motors without controllers, switches and resistances in the main circuit, and all changes in the power applied to the motors are gradual and do not interfere with the regulation of the primary distribution system. On this account the power factor of the primary current required by the locomotive may be maintained at unity, which will materially reduce the capacity of the power and distribution equipment.

This locomotive will return energy to the primary system, due to the momentum of the train, whenever desired, which is considered of advantage when the train is coasting.

This system has been applied to a section of the State Railway in Switzerland, and is reported to have reached a high state of development, and its many advantages have already been fully described by its inventor. However, as the generator on the locomotive is a direct-current machine, it has to be equipped with a commutator

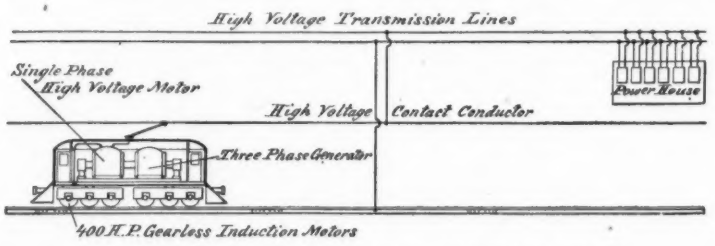


FIG. 5.—HALLBERG SINGLE-PHASE TO POLYPHASE SYSTEM.

and permitting good commutation, the speed of the single-phase motor and this generator will have to be comparatively low, which means that the motor-generator set will be large; therefore, there is not sufficient room on one locomotive to place a motor-generator set larger than 1,000 hp, which, of course, limits the usefulness of this locomotive, unless two or more are operated in parallel in one train. The necessity of one commutator on each motor-generator and one on each of the driving motors is probably the greatest drawback to this system for trunk line railway service. However, as the local voltage on the locomotive for the driving motors can be made very low, if desired, and on account of the absence of switching and controlling devices for the heavy main currents, this locomotive possesses advantages over all others using commutator-type motors.

Fig. 5 illustrates in diagrammatical form the Hallberg single-phase to polyphase railway system. Referring to the drawing, the simplest form of power house and distribution system is shown, and only one high-voltage contact conductor is required along the railway and only one contact device is required for each locomotive.

The high-tension current collected by the locomotive furnishes power for a single-phase synchronous or induction motor, which drives a three-phase, alternating-current generator; both of these machines being of the design now commonly used in connection with steam turbines. The use of this type of motor and generator on the locomotive allows for a large capacity, inasmuch as a 2,500-hp motor-generator set can readily be installed in a standard car.

The primary power on the trolley wire may be any voltage up to 15,000 volts, having a frequency of about 25 cycles. The single-phase synchronous motor would have two poles. This would make the speed of the motor and the three-phase generator 1,500 r.p.m.

The three-phase generator would be provided with four poles with special connections, so that the polarity of one set of poles could be reversed. This would give two adjacent north poles and south poles, which would deliver 25-cycle current from this generator to the driving motors. After the driving motors have come up to half speed the polarity of the set of poles referred to would be changed and the rotation of the poles on the generator would be north-south, north-south, which would make four poles, and the frequency of the currents delivered to the driving motors would then be 50 cycles and the motors would be in a position to run at full speed.

In addition to the speed control obtainable by change of frequency, the intermediate speeds can be provided for by changing the current in the fields of the three-phase generator, which will make a proportionate change in the current delivered to the driving motors. Further speed control can be obtained by introducing resistance in the secondary of the motors, if necessary.

The driving motors are of the standard three-phase induction type and could be wound for 50 cycles and approximately 1,000 volts.

With this equipment, as described, the operator has entire control of the local train circuit, without disturbing or introducing lagging currents in the primary system, and, furthermore, when the locomotive has to climb a grade, the voltage on the three-phase generator on the locomotive can be increased, and the induction motors will accordingly increase in capacity and can be made to deliver nearly double their rated power for a considerable period without any injury to any part of the system. This is an important feature, and this locomotive is the only one of those described which has this advantage.

When the train is coasting the induction motors act as generators, and, if the poles on the three-phase generator are altered, so as to make two active poles, the generator becomes a motor and the single-phase synchronous motor will act as a generator, thus returning power to the primary system at the will of the operator.

This feature is of great importance on trunk line railways, as it not only saves power, but the wear and tear on the wheels and brake equipment is reduced to a minimum, and it is possible to reduce the full speed of the train to one-half, without setting the brakes and consequent jarring of the train, which will make it pleasant for occupants of the sleeping cars and coaches.

With the Hallberg system any number of locomotives can be operated on the same section up to the capacity of the power house, wires and cables, inasmuch as the sub-station equipment is carried with the locomotive, and the failure of any part of the transforming equipment on the locomotive does not disable more than one locomotive, whereas with some of the other systems a section of the railway may become inoperative.

The absence of commutators, switching devices, resistances and gears, as well as all other delicate parts which require repair and attention, should make this type of locomotive and system thoroughly commercial, and the up-keep of this system would be negligible.

By reason of the fact that the local power circuit on the locomotive is electrically and magnetically independent of the primary distribution system the use of large air-gaps between the stator and rotor members of the induction motors mounted on the trucks are permissible, inasmuch as the lagging currents, due to low power factor in the local power system on the locomotive, cannot disturb the regulation of the primary distribution system, but simply affect the capacity and the regulation of the polyphase generator on the locomotive, which is entirely under the control of the operator, and which could stand 100 per cent. overload for some time without any difficulty.

The frequency of the current on the primary distribution system may be chosen without regard to the driving motors, which receive their current from the local generator on the locomotive, and which can be made to supply currents of a frequency and voltage most suitable for the driving motors.

The approximate weight of a 3,000-hp locomotive of this type, including the motor generator set, would not exceed 175 tons, and in case of an emergency the electric equipment could be depended upon to deliver more than 4,000 hp without liability of crippling any part of the system, in view of the fact that there are no commutators, brushes, contactors or resistances, which have to carry the power currents.

On account of the simplicity of the line construction and the small wires permissible with this system, and, as high-speed, turbine-type, alternating-current machines can be used for the motor-generator set

on the locomotive, the cost of this system should be lower than for any of the others described.

The expiration of the polyphase motor patents in May, 1905, should also reduce the purchase price of the induction motor equipment, the cost of which should be comparatively low, in view of the fact that the motors do not have to be designed for any given voltage or frequency, both of which can be selected to suit the motor equipment.

The rugged construction of the electric equipment permissible with the Hallberg locomotive will appeal to those who have had experience in designing and operating large commutator-type motors for locomotives.

Fig. 6 illustrates the Hallberg locomotive on one of the low-voltage sections, where it receives, through the two contact conductors,

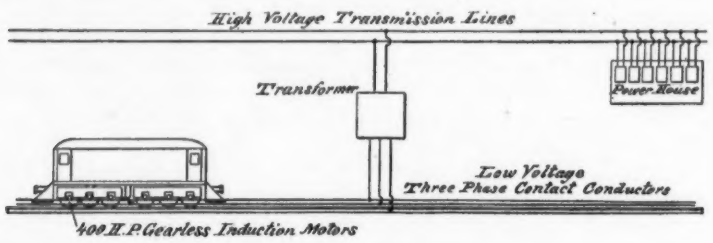


FIG. 6.—HALLBERG LOCOMOTIVE.

which may be placed either on the ground or overhead, three-phase alternating current at low voltage, preferably at a lower frequency than that for which the three-phase driving motors are wound, which will be the means of high starting torque, and the maximum speed limit will consequently be reduced, depending upon the frequency of the currents thus applied.

The Hallberg locomotive will also operate on the distribution system for systems Nos. 3 and 4, which is a valuable feature.

The comparative efficiency of the systems described considering the input of power at the generator shafts in the power house and the power available at the wheel base would be approximately as follows: System No. 1, 56 per cent.; system No. 2, 65 per cent.; system No. 3, 61 per cent.; system No. 4, 62½ per cent.; system No. 5, 65 per cent.

Of the five systems referred to in this article, there are only two which make use of driving motors without commutators, and these systems should receive favorable consideration, as the application of all commutator type motors to locomotives for trunk line service may involve considerable risk.

The Electrical Testing Laboratories.-II

By CLAYTON H. SHARP.

MAGNETIC TESTS.

THE accurate determination of the permeability and hysteresis of iron and steel, as well as the change of these quantities with use, is of great importance to all builders of electromagnetic machinery. In view of the great discrepancies found in the results obtained by various experimenters using different methods in making magnetic tests, great care has been exercised, in selecting methods and apparatus, to adopt only such as are free from influence by the errors which ordinarily enter in or such as permit these errors either to be corrected for or eliminated from the results. The latest information on this subject has been made use of, particularly that published by the Reichsanstalt as a result of their thorough investigations of this branch of testing. As a result the following methods have been adopted for the magnetic testing of iron, either in solid pieces or in sheets.

The first of these is the well-known and recognized ring method. Suitable rheostats, wires and switches are installed on the magnetic testing table for connecting the ring windings, ammeter and ballistic galvanometer. A reflecting d'Arsonval galvanometer of low period and undamped is used for the ballistic measurements. Its constant can be obtained in two ways:

1. By taking throws of a condenser discharge and correcting the latter for the logarithmic decrement of the galvanometer.

2. By taking throws produced by reversing a known direct current in the primary winding of a standard of mutual induction, the secondary turns of which are connected in the galvanometer circuit. The standard of mutual induction has been made in the laboratory by winding a helix of No. 18 copper wire on to a length of fibre conduit, which had been turned true, and the dimensions of which can be measured with accuracy. On the outside of the primary winding is wound a secondary of No. 36 double silk covered wire. The coefficient of mutual induction of these coils has been obtained both by computation from their dimensions, making proper allowances for the action of the ends of the long helix, and by measurement on the Wheatstone bridge against a standard condenser. This method of standardizing the ballistic galvanometer has two advantages.

1. It gives the constant of the galvanometer directly in terms of lines of force cut per centimeter throw.

2. It enables the constant to be quickly determined under all condition of damping. This is of great importance, since the damping coefficient varies with the amount of resistance in the galvanometer circuit.

The ring method has the inconvenience that the specimen must be turned in this particular form, that primary and secondary windings must be carefully placed on it and counted, and that the method of making observations is rather slow. Moreover, the results so obtained are subject to correction if the ring has not a radial thickness which is small in comparison with its diameter, and if its cross-section is not considerable as compared with its surface area. It is particularly important to make commercial tests of iron on standard samples which are readily turned up in a lathe. This requires the use either of the magnetometer method or of the yoke method, the latter of which only needs to be considered.

Two pieces of apparatus have been installed for making tests of samples by the yoke method. The Koepsel permeameter, made by Siemens & Halske, is one of these. The yoke of this instrument, which is of very large cross-section, as compared with the test piece, contains a narrow air-gap similar to the air-gap in the magnetic circuit of a voltmeter, in which is placed an ordinary voltmeter movement of the Weston pattern. The magnetic flux through this air-gap is equal to the flux through the test piece; consequently, when a current is sent through the moving coil its deflections are proportional to **B**. The scale over which the pointer moves is therefore graduated to indicate **B** directly when a current of definite value is passing through the coil. The values of **H** are deduced from the indications of an ammeter connected in series with the magnetizing coil about the test piece. These values, however, are subject to correction on account of the reluctance of the joints, the yoke and the air-gap in the circuit. This correction is applied by shearing the magnetization curve by an amount which depends upon the material tested. The apparatus has been subjected to a thorough test at the Reichsanstalt and the amount of this shear for four different typical specimens has been determined. Consequently, when the values of **B** for a piece of soft steel, for instance, have been determined by means of this instrument, the values of **H**, as read on the ammeter, are corrected according to the shearing curve for this material. If it is desired to obtain a hysteresis loop with greater accuracy than can be done by applying this approximate correction, the value for the coercive force of the material is determined by a simple magnetometer experiment. This fixes the maximum width of the hysteresis loop, and an approximate value of the shear is sufficient to give the form of the rest of the loop with a good degree of accuracy. Where comparative values only are desired, as in the determination of the aging of transformer sheets, these corrections may be omitted and the indications of the instrument taken directly. Since the process of determining a magnetization curve requires only the reading of an ammeter and of the permeameter needle, this work can be executed with very great rapidity, and with very little liability to accidental errors. The great convenience of its manipulation is a very strong point in its favor as a commercial instrument.

In view of the discrepancies which are often met with in the magnetic testing of iron and of the general desirability of obtaining results which do not require the application of any correction of more or less unknown value, another form of permeameter has been installed which, while less convenient of manipulation than the Koepsel permeameter, yet yields results which are theoretically independent of the reluctance of the joints and of the yoke. This is the Picou permeameter, made by Carpentier. The idea underlying the instrument is this: Since the yoke and the joints add an addi-

tional reluctance to the magnetic circuit, which in the ordinary Hopkinson or Koepsel apparatus must be overcome by the magnetizing coil about the specimen, it is necessary only to apply a certain number of ampere turns to the yoke itself in order to compensate for this additional reluctance, the only difficulty being to determine the proper number of such added ampere-turns. In the Picou permeameter this is accomplished as follows:

The yoke is square in form, the test piece being so placed as to divide the square into two halves. On each leg of the square, parallel to the test piece, is wound a certain number of turns of wire, the number being equal on the two legs. There is also a magnetizing coil and a test coil about the test piece. The operations are as follows:

1. A current is sent through the coils on the two legs of the yoke connected in series and so that the magnetic flux from each is in the same direction about the yoke. The amount of this flux may then be determined by a throw of the ballistic galvanometer or otherwise. None of this flux passes through the test piece, since its extremities are at equipotential points.

2. The current in one of the coils is reversed, causing the magnetic fluxes to oppose each other and reducing the total magnetic flux in the yoke.

3. Current is sent through the magnetizing coil about the test-piece until the flux through the yoke has been restored to its original value. When this is the case, the magneto-motive force applied to the yoke by the yoke windings is just sufficient to carry this flux around the yoke. Consequently the magneto-motive force applied to the test-piece needs only to carry the magnetic flux in the test piece from one end of the test piece to the other.

The value of this magnetomotive force is determined by an ammeter reading and the value of the flux in the test piece by the throw of a ballistic galvanometer. The values so determined are free from error due to the reluctance of the joints and of the yoke. This operation, while more complicated than that of the Koepsel apparatus, is considerably facilitated by auxiliary devices in the permeameter itself. The arrangement of the wiring and switches for test by the ring method is equally applicable to the Picou permeameter, so that either a ring or the permeameter may be connected to a certain set of leads and is at once ready for use.

STANDARDS OF LIGHT.

A matter of prime importance in a photometric laboratory is the question of the standards of luminous intensity which are to be employed. At the present time the most practical and generally recognized standards are the 10-cp Harcourt pentane standard, which is legalized in Great Britain and used to a considerable extent in gas practice in this country and the Hefner lamp, which is the legal standard in Germany, and is also used extensively elsewhere. Both of these, being flame standards, are subject to variations due to atmospheric conditions. The amount of aqueous vapor in the air has a particularly strong influence on their luminous intensity, causing it to vary several per cent. Consequently, the use of these standards for measurements of precision is attended with considerable experimental difficulties and no little uncertainty.

It is accordingly advisable, in conducting an electrotechnical laboratory where influences of this sort should play no part in the actual measurements, to establish, once for all, the value of the standard to be used in terms of a series of seasoned incandescent lamps standardized carefully against the primary standard. Having done so, it is possible to cut loose from the flame standard entirely and to maintain an invariable standard of light by reproducing these incandescent lamp standards. Absolute invariability of the standard is of far more importance than the exact value which it possesses, and in no other way is so good a degree of constancy obtained as by the proper use of a series of incandescent lamps. This course has been pursued by the Electrical Testing Laboratories. The standards of the laboratories have been derived from lamps so standardized at the Reichsanstalt about 15 years ago. Recent measurements by the Reichsanstalt authorities of standard lamps in actual use in the laboratories have established very definitely that the value of the standard has not varied appreciably during all the intervening years.

According to these measurements the Hefner unit is equal to 0.88 of the candle-power represented by these standards. This is the generally accepted ratio for Hefner unit divided by British candle, established by the Reichsanstalt authorities themselves. Intercomparisons of the Laboratories' standards with those in use by the Laboratoire Central d'Electricité in Paris have shown that the Laboratories' candle is substantially equal to the bougie décimale which is numerically the 1/20th part of the Violle absolute platinum unit, and is the standard actually used in French practice. Similar comparisons with the National Physical Laboratory of England have shown a close agreement between their candle and the candle-power of the Electrical Testing Laboratories. The candle-power used by the National Physical Laboratory is derived from the 10-cp pentane standard corrected for atmospheric conditions. Moreover, the agreement is complete between the candle-power of the Electrical Testing Laboratories and the National Bureau of Standards. In view of the fact that the candle-power used by the Electrical Testing Laboratories is well-nigh universally employed in electrotechnical photometric practice in this country, the state of affairs revealed by the above comparisons is a most gratifying one. The Electrical Testing Laboratories prepares and keeps on hand for sale standardized incandescent lamps, reproducing the above standard. For photometric measurements, involving the use of gas flames which themselves are subject to change due to the same atmosphric conditions as affect the standard lamp, the 10-cp pentane lamp is used as a standard.

PHOTOMETRIC LABORATORY.

In planning the photometer rooms especial attention was given to securing good ventilation and an abundance of space for installing and operating the apparatus. Recognizing the considerable degree in which the personal equation may enter into photometric results, great care has been taken to secure the greatest comfort of the operators and to diminish the amount of fatigue connected with their work. With this in view, most of the photometers are arranged so that measurements are made with the operator sitting comfortably in a chair. Ceiling fans contribute greatly to comfort in warm weather. The interiors of the photometer rooms are painted dull black, the principal reason for doing so being to protect the eyes of the operators from any outside light which would tend to diminish their sensitiveness and to increase fatigue. In all cases, special care is taken to prevent stray light from falling on photometer disks.

The method invariably employed in making photometric measurements is such as to eliminate personal and instrumental errors from the results. This is accomplished by a process analogous to "double weighing." In other words, all readings are the result of indirect rather than of direct comparison of the lamps tested with the standard lamps employed. This indirect comparison is made by measuring successively the standard lamps and the test lamps against an invariable source of light which is called the "Working Standard." Since both operations are performed by the same operator, any lack of symmetry, either in the apparatus or in the operator's eyes is minimized if not entirely eliminated from the results.

In cases where measurements are made with mirrors interposed between the light to be tested and the photometer, the same method is followed, so that the absorption of the mirror entering both into the measurement of the standard lamp and of the test lamp is automatically corrected for. It is only by this method that results obtained by one operator on one photometer can be closely duplicated by another operator on another photometer, and using this method there is no great difficulty in obtaining such duplication of results.

The current for photometrical measurements is supplied from a number of storage batteries of proper size to do the work. The various circuits from the photometers are carried to a distribution switchboard in the machinery room, to which the battery circuits are also brought. Flexible cords and plug connectors enable any combination of batteries to be used on any photometer. Steady alternating current from the life-test circuits can also be brought to the photometers, using the same switchboard. This is necessary in the photometry of certain sources of light which should be used only on alternating currents.

INDUSTRIAL PHOTOMETER ROOM.

This is a large room, 24 by 50 feet, containing six photometers intended for ordinary industrial measurements of incandescent lamps, and one photometer more especially designed for studying the distribution of intensity about lamps and about lamps with shades or reflectors. A general view of this photometer room is shown in Fig. 13. The photometers are of the same type as is ordinarily seen in lamp factories, but they have been greatly improvd and refined for the more exacting work which is required of them. The distance between lights is 100 inches. One lamp, the "working standard," is

mounted in a fixed position in a box at the right-hand end of the photometer. The rotator in which the standard lamp and the test lamp are successively placed projects through a table top at the left-hand end of the photometer. These rotators are driven by belts from a line shaft. The photometer track, scale and sight-box are enclosed on three sides in a kind of large box, only the front being open. The track, which consists of angle irons, is supported near the roof of this box. The sight-box is suspended below the track. This leaves the table top beneath entirely free for other purposes. The scale is placed far back, so that it is invisible when settings are being made and must be illuminated by a miniature lamp in order to be read. Graduations on the scale are directly in terms of candle-power, the 16-candle point being placed midway between the two lamps. The sight-box is moved by an arrangement of cords and pulleys, such that to manipulate the sight-box the operator needs only pull in one direction or the other on an endless leather belt passing over wheels at the ends of the photometer track, whereby the fatigue involved in

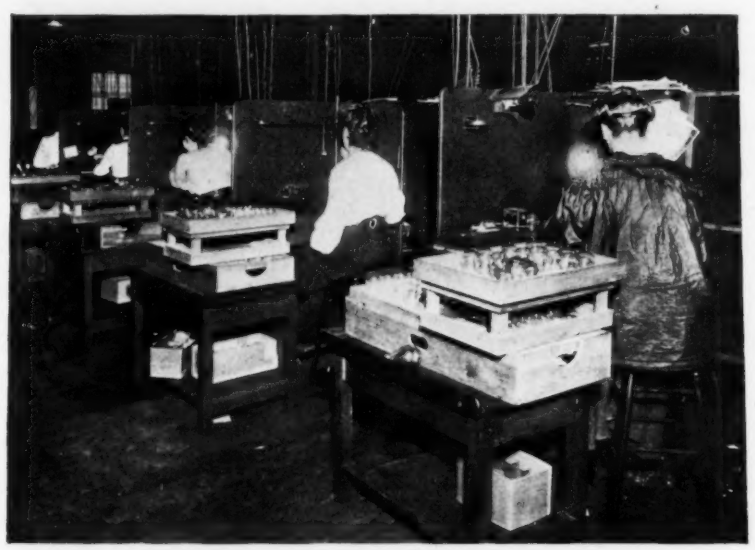


FIG. 13.—INDUSTRIAL PHOTOMETERS.

lifting the hands to the height of the sight-box is avoided. For controlling the current to the lamps, slider rheostats are employed. In series with each lamp are two such rheostats, one placed in front of the operator who is making the photometric settings and the other within range of the operator who is placing the lamps in the rotator. This enables either operator to control at will the voltage on either lamp.

The instruments employed are a Weston laboratory standard voltmeter at the left-hand end of the photometer near the rotator and a Weston laboratory standard millivoltmeter, used with a shunt under the photometer track. These instruments are carefully protected from injury and dust, and are read through plate glass covers. In ordinary work any small error of the voltmeter, providing that it be constant over the range of voltages which the standard and test lamps cover, does not need to be regarded, since if the voltmeter indicates 1-10 per cent. high or low on the test lamp it does the same on the standard lamp and the influence is negligible. Nevertheless, lines have been run from each photometer to a potentiometer installed in an adjacent room, by means of which the voltmeters can be accurately checked in situ. The ammeters can also be checked by the same potentiometer, using a standard resistance, permanent wiring being installed for this purpose as well. In ordinary practice the ammeters are checked by noting their indication when a lamp of known ampere consumption, at given volts, is placed in the rotator and brought up to its marked voltage. The difference between the standard value for this lamp and the indication of the ammeter gives the correction to the ammeter, the current passing through the voltmeter being included in the correction. For general purposes this method is preferable, since it is a "double weighing" operation.

An unusual feature in these photometers is the arrangement of screens to protect the disk from stray light. To each side of the sight-box is attached a lazy tongs which carries seven aluminum screens. As the sight-box is moved, the screens on one side approach each other and on the other side move farther from each other, but always remain equally spaced and always furnish a very efficient arrangement for cutting off the stray light, as well as for shielding the operator's eyes from light from either lamp. This excellent scheme has been developed by the General Electric Company's lamp works.

LIFE-TEST ROOM.

The arrangements for conducting life-tests of incandescent lamps have been worked out with great care and on a very extensive scale. The general arrangment of racks and sockets for carrying lamps undergoing life-test is shown in Fig. 14. It will be seen that the sockets into which lamps are screwed are placed on slats supported by racks. Sufficient space has been left between lamps so that there is no likelihood of their influencing each other by mutual radiation. The lamps burn in a horizontal position, thus giving a maximum opportunity for the development of the fault of drooping in the filament. This position is unchanged throughout the life-test. The racks themselves are made of fireproofed wood. As has been said, the current for feeding lamps on life-test is obtained from a 60-cycle alternator. The wave-form of this alternator approaches quite nearly to a sine curve. This current, which is generated at 117 volts, is fed into an auto-converter or compensator having 41 outlet taps. These taps are so spaced that the difference in the e.m.f. of two successive ones is approximately 1 volt. In this way all integral voltages from 100 to 140 are obtained, corresponding to the ordinary range of lamp voltages. Lines are carried from these taps to the various racks in the life-test room, the number of sockets attached to any one line being proportional to the relative number of lamps which are ordinarily tested for life at the voltage corresponding thereto.

Since it is of the highest importance that the voltage which a lamp on life-test is subjected to should not vary from its nominal value, extraordinary precautions have been taken to prevent any fall or rise in this voltage with changes of load. The lines leading to the rack have been made unusually heavy. The return circuit connecting the various racks with the other side of the generator circuit is made of massive copper bars tied together and of such size that an appreciable voltage drop in the line is impossible. About five and one-half tons of copper have been used for this purpose alone. The total number of lamp sockets provided is 6,000. The proper voltage for each life-test lamp is determined by a photometric measurement to the nearest tenth of a volt. Since the compensator gives voltages in one volt steps, it is necessary in most cases to insert a small resistance in series with each lamp to bring the voltage impressed upon it to exactly the proper value. A large supply (7,500) of such

FIG. 14.—LIFE-TEST RACKS.

resistances ranging from 0.1 Ω to 5.0 Ω is on hand. From these the proper one is readily chosen.

The ordinary life-test of a lamp (according to this method, consists in measuring the voltage at which it gives initially its rated candle-power and its watts per candle, then afterwards determining its candle-power and watts per candle after 48 hours, 144 hours, 240 hours and 336 hours, etc., continuing the measurements at similar intervals until the candle-power of the lamp has dropped to 80 per cent. of its initial value, this being considered the end of the useful life of the lamp. From data so obtained a curve of the life performance of lamps can be plotted and the length of their life, the total light in candle-hours and the average watts per candle determined.

New College of Engineering. The George Washington University, Washington, D.C.

By N. Monroe Hopkins, Ph.D.

MONEY is being subscribed all over the United States for the new George Washington University at Washington, destined to become a great post-graduate university of national character, with affiliated colleges like the Oxford system in England. Under the administration of the new president, Dr. Charles W. Needham, the University is expanding along the broadest possible lines and with the highest aims toward a magnificent culmination. At a meeting of the board of trustees of old Columbian University on June 8, 1904, a resolution changing the name to The George Washington University was unanimously adopted. The new name was on the 22d day of June approved by the Secretary of the Interior and the United States Commissioner of Education. This action was taken under a recent act of Congress approved January 23, 1904.

On the same day the certificate to change the name was filed, a certificate of organization was issued under the general laws of the District of Columbia, organizing the Columbian College. This corporation was formed by the direction of the board of trustees of the University for the purpose of preserving and continuing the old name, Columbian College. This college, now the first of the system of affiliated colleges, has charge of the undergraduate students and is under the general direction of the board of trustees of the University. The new College of Engineering will be affiliated in the same manner with the University. Before outlining the plans of the College of Engineering a few words concerning the George Washington University will not be out of place. In December, 1897, a body of patriotic women, representing the various States in the Union, met in the city of Washington, and the result of their conferences was the incorporation of The George Washington Memorial Association. The objects of the association were stated to be "To advance and secure the establishment in the city of Washington of a University for the purpose and with the object substantially set forth in and by the last will of George Washington, the first President of the United States, and to increase the opportunities for higher education of the youth of the United States." The membership of the association increased, and considerable sums of money were given and subscribed by patriotic persons throughout the country to a permanent building fund held in trust by the association for the proposed memorial building. The sum of money being raised for this memorial building, to be the central building of the group of new university edifices, is $500,000. The association in its inception had in view the establishment, by Congressional action of a university having an organic relation with the Federal Government. It became apparent that the attempts to establish such a university could not succeed. A movement was then started by the Washington Academy of Sciences to establish educational facilities for research and graduate work. This resulted in the incorporation of the Washington Memorial Institution. The Institution had before it the work of general research and the utilization of the facilities in the departments at Washington for graduate students in colleges and universities. The establishment in 1902 of the Carnegie Institution provided for the first object in view by the Memorial Institution—that of research work. The second object, an institution for graduate students, remained to be adequately provided for.

In the fall of 1903 conferences were held between the representatives of the Washington Memorial Institution and the Columbian University looking to a suitable provision for this work. The University proposed to have its charter changed, making the Institution non-sectarian, electing to membership upon its board of trustees representatives from the Memorial Institution, enlarging its courses and corps of professors to carry on the proposed graduate work at Washington. At the same time negotiations were entered upon with the George Washington Memorial Association looking to the fulfillment of its objects by the building of a George Washington Memorial to be used as the administration building for the University under this reorganization. These conferences came to a very satisfactory conclusion, and a bill was introduced in Congress making the University non-denominational, and giving to the board of trustees power to change the name.

The George Washington University has to-day in all its departments 1,445 students, every State in the Union and the Territories being represented in the student body as well as thirteen foreign countries. There are now 206 officers of administration and instruction and in the Department of Arts and Sciences graduate work of the highest order will be carried on under the ablest professors and instructors. It is expected that arrangements will be made with colleges throughout the country by which upon certificates of graduation from the colleges, the students will be received into the University at Washington for all post-graduate work, assisting the smaller colleges to retain their students for the baccalaureate degrees and giving the students the opportunity to take their graduate degrees from this University. It will also be the policy of the University to enter into reciprocal relations with other great universities by which students will be given the opportunity to take advantage of the great facilities in Washington for special work, receiving credit in their own institution from which they come. This arrangement will also give the students of the George Washington University the opportunity to take special work in other universities, for which they will receive due credit here.

The new University has just purchased a new piece of land, fronting upon the Presidents' Park, immediately south of the White House, and facing south upon the new Potomac Park. The Government grounds immediately around this new site contain about 1,000 acres. The accompanying plan shows the position of the new University grounds in relation to the Washington Monument and White House.

This park is being steadily improved by the National Government and will in time be one of the handsomest reservations in the world. These public grounds will give the students of this University the largest opportunity for recreation and athletic sports, including a boat club, as may be seen, upon the nearby Potomac River. On either side of the mall and within easy walking distance of the University are the permanent public Government buildings, with their libraries and laboratories all open to the student. As the city grows and expands nothing can impair the desirability of this site; on the contrary, its importance and desirability will grow with the increasing number of public buildings around the University. Additional land can be easily acquired, as may be seen by the white squares upon the above plan, at a very reasonable cost as soon as money for the purchase is provided. The new site of the University is indeed a beautiful one, and its desirability is emphasized by the fact that students can reach all of the great educational facilities of Washington by walking across a beautiful park. This University is completely organized as pointed out, having already more students than Princeton, and a long and large body of alumni. National in its aims and purposes, and thoroughly qualified under its present arrangement to carry out and realize the objects that have been in the minds of many patriotic men. Its original charter (Columbian University) dates back almost to Washington's day. Its new site is near the one selected by Washington, its aims are broad and national, and it seems to meet in a peculiar and happy way all the plans and make possible the ideals of George Washington regarding a national University in the Capital City. The following illustration represents a tentative group of buildings upon the new site, with the George Washington Memorial in the center. The buildings for the Department of Arts and Sciences and Engineering, Chemistry, Physics, Astronomy, etc., etc., the designs of which are not yet complete, will be placed upon adjacent sites, as shown upon the plan. The old buildings of old Columbian University, situated in the heart of the most valuable part of Washington will be sold, and the money invested in the new developments upon the recently acquired site.

THE COLLEGE OF ENGINEERING.

Plans are now in preparation for a College of Engineering to be one of the system of affiliated colleges under the University, one that will be the finest in point of equipment and resources for the student in the United States. This will be commenced as soon as sufficient funds are subscribed to carry on the work. The plans will provide for a separate building for this college, about 150 by 200 ft., and be three stories high of a type of architecture befitting its beautiful surroundings. This college will have its own faculty and board of trustees like Columbian College. The courses in Mechanical and Electrical Engineering will include work under three general divisions. First, theoretical instruction by the professors of the university as well as by the professors and instructors of the College of Engineering. Second, laboratory and shop work under the direct instruction and supervision of the University and college instructors. Third, researches and tests upon a chosen number of the many large and modern engineering plants doing regular commercial duty in Washington. There is opportunity in Washington for study in the

most magnificent libraries the country affords, as well as opportunity for testing the most varied types of scientific and engineering apparatus. For assistance in the theoretical instruction, Washington

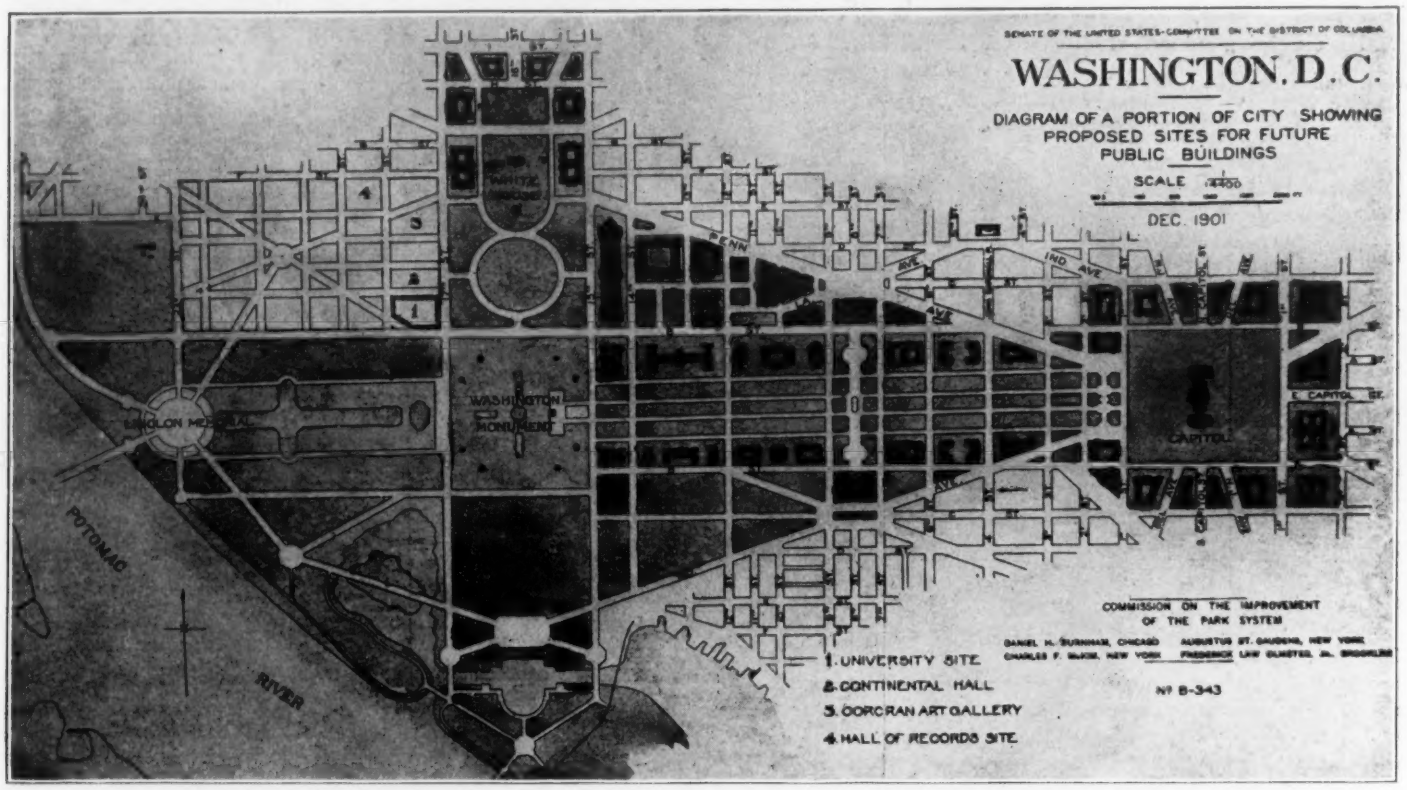


Fig. 1.—Portion of City Plan Showing New University Site.

offers many and marked advantages, unrivalled in any other place in America. Experts who are in the fore-rank of investigation, or who have the latest knowledge of the advance made in the subjects, navy. The United States Army War College, the United States Weather Bureau, the United States Engineer and Signal Corps, the Engineering Department of the District of Columbia, the United

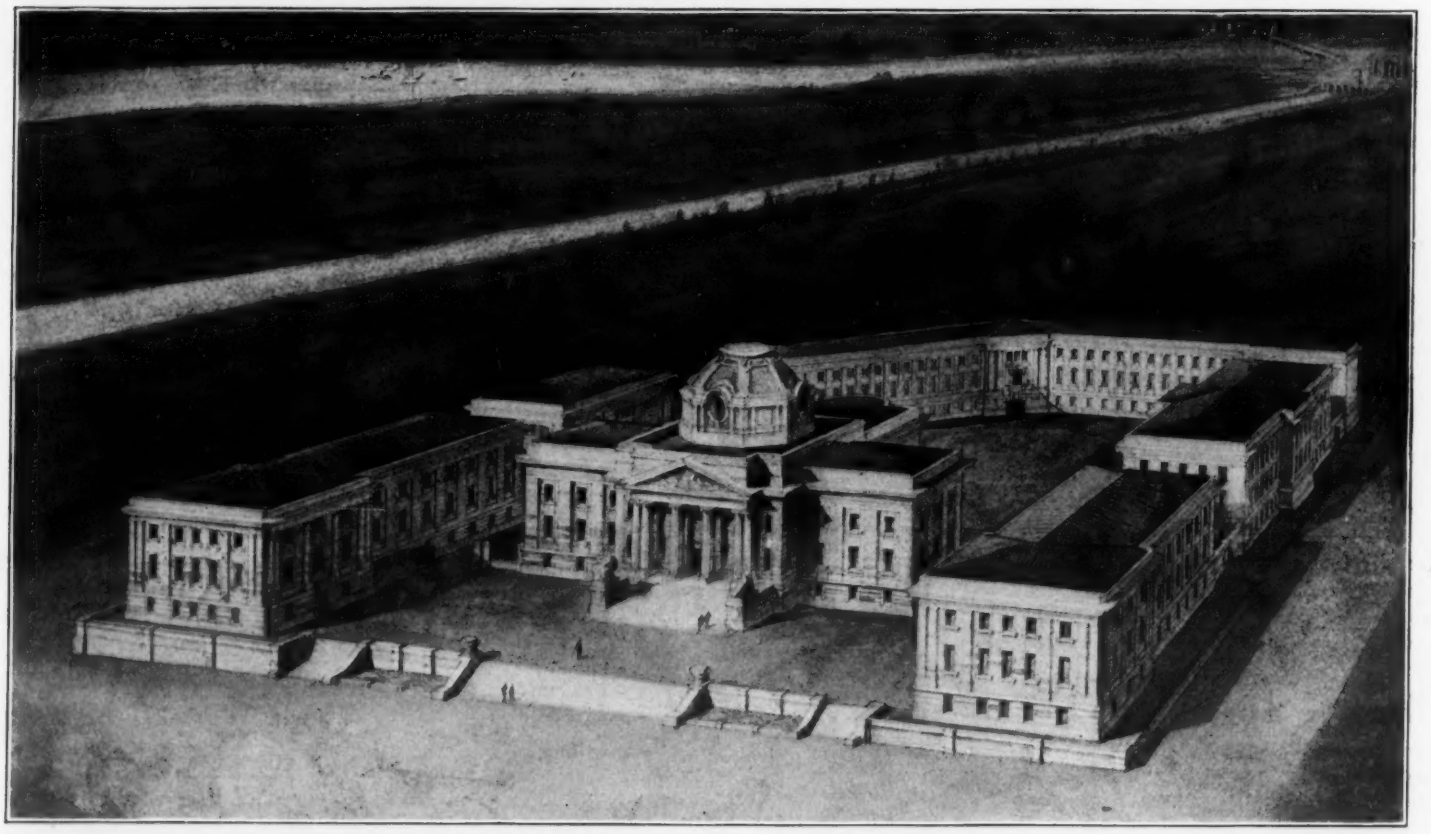


Fig. 2.—Tentative Plan of Group of Buildings on New Site.

are in many of the government bureaus. Among the places from which such men are and may be drawn are the Smithsonian Institution, the National Museum, the United States Bureau of Standards, the United States Patent Office, the Engineering Bureaus of the States Coast and Geodetic Survey, the United States Geological Survey, the Carnegie Institution, the United States Naval Observatory, etc., etc. It is of interest to point out that all these grea Federal institutions have their magnificent special libraries, apart from the

new Library of Congress, which are open to the properly qualified students of the University, as well as the shops and laboratories. Among the modern power plants available for test and study here are the pumping station of the District of Columbia Water Works, the Potomac Electric Power Company, with a capacity of 18,000 hp developed by the most modern and approved machinery, including a recently installed steam turbine plant, the modern power and lighting plants of the United States Capitol building, the Library of Congress building, the power plant of the United States Navy Yard, the central light and power plant of the Department of the Interior, the Washington Railway & Electric Company, the Capital Traction Company, the Chesapeake & Potomac Telephone Company, etc. The interest, kindnesses and courtesies shown to the professors, instructors and students, in the University in the past make it certain that every facility and assistance will be given to the new College of Engineering in the future. There are in addition to the Government and municipal engineering plants, numerous private engineering equipments for electric lighting and power, the manufacture of liquid air, etc., etc. In Washington are to be found the men and the material equipment of inestimable worth to the research student in engineering. The University now publishes regularly scientific bulletins from its rapidly growing Department of Arts and Sciences. Many scientific men are anxious to see this College of Engineering started at Washington and are assisting in its development. Those interested in securing further information relative to the future of this institution, as well as those caring to assist it materially will please communicate with Dr. N. Monroe Hopkins, The George Washington University, or to the president of the University.

New Telephone Patents.

A NEW TYPE OF RELAY.

A novel type of sensitive relay is one just patented by Mr. W. W. Dean, the patent being assigned by him to the Western Electric Company. No magnetic material is included in the movable armature part and thus the effects of retained magnetism, so troublesome in most relays, are eliminated.

A description of the relay may be best given in reference to Fig. 1, which includes a sectional view, an end view and two views of the moving part.

This latter consists of an upright plate of insulating material which carries a copper spool wound with few turns of wire. It also carries, but upon its opposite face, terminal plates for the coil and a pivot plate with a contact anvil attached thereto. The relay core carries

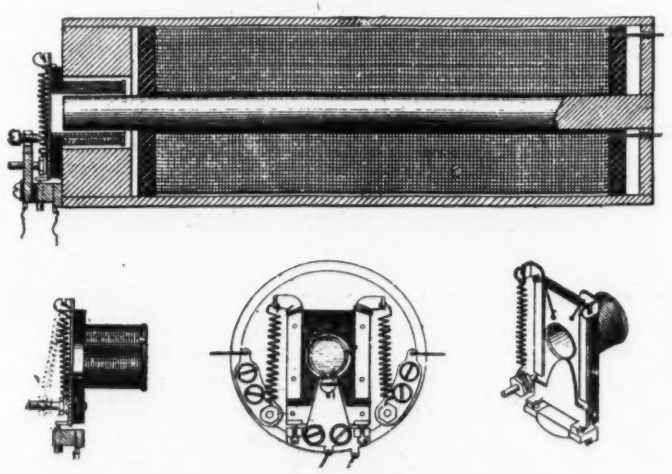


FIG. 1.—DEAN RELAY.

a magnetizing winding spool covering the major portion of its length, while over the exposed end the armature solenoid is placed. This latter being supported from the pivot, and having a bore larger than the core section, clears the core all around, and is free to advance slightly and retreat over the core in the direction of its length. The electric circuit is carried out from the moving part from its adjusting springs, which hook into notches in the terminal plates at one end and between clamping nuts on threaded studs at the other end, these studs serving as terminals. The method of adjustment is evident from the cut.

As a supervisory relay the talking circuit is carried through the movable coil of few turns and low resistance and inductance; the magnetizing circuit is controlled by the position of the plug in a spring jack, while the contact points control the usual lamp shunt.

ANTISEPTIC DEVICES.

In Figs. 2, 3 and 4 are shown three new antiseptic devices, patented respectively by Messrs. W. H. Rose, of Catonsville, Md.; Henry Baethig, of Buffalo, and A. B. Cruickshank, of London, England. The device is of the "sheet of paper" type, this being Mr. Baethig's

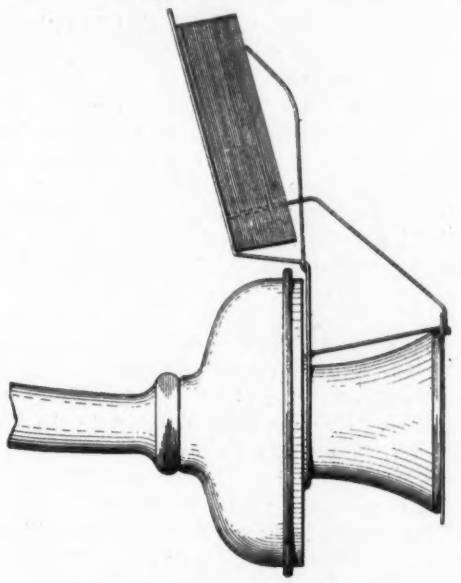


FIG. 2.—BAETHIG ANTISEPTIC DEVICE.

invention. Each user of the transmitter may tear off the paper hanging over the mouthpiece, and then drop a new piece from the pad, sliding it along the guide wires.

In Fig. 3 is shown in section Mr. Rose's attachment. This is a metal sheathing lined with felt, adapted to be clamped over the

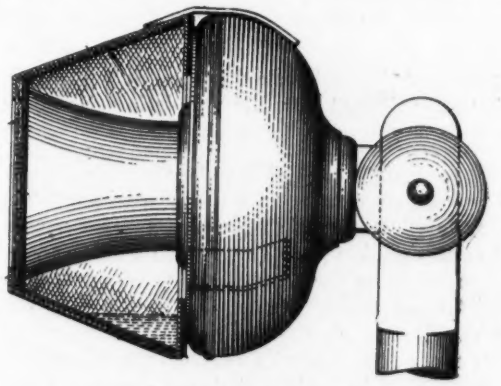


FIG. 3.—ROSE ANTISEPTIC DEVICE.

mouthpiece. An opening in the sheathing registers with the aperture of the mouthpiece and this opening has stretched across it a wire screen and a film of fibrous gauze. The antiseptic liquid is placed in the sheath as indicated, and keeps the gauze wet by capillary attraction.

The third type, that of Mr. Cruickshank, consists of an annular

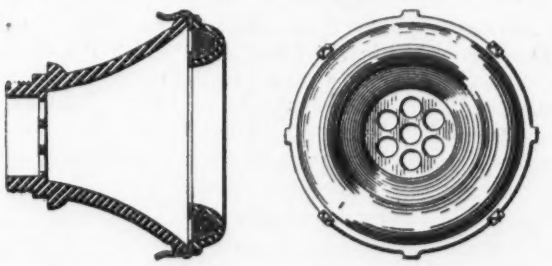


FIG. 4.—CRUICKSHANK ANTISEPTIC DEVICE.

box which clamps over the mouthpiece. One face of this box—that turned in—is perforated. The box is filled with absorbent material, saturated with an antiseptic solution, the fumes of which pervade the inside of the mouthpiece.

PARTY LINE APPARATUS.

A peculiar party line apparatus has been patented by W. Parker, of Leicester, New York. This apparatus is for private lines and is so arranged that the line may be rung upon in either direction at will from each station, so that in talking from any station the line is cut in two at that station, the connection being made to either section of it at will.

AUTOMATIC EXCHANGE SYSTEM.

It was proved a considerable time ago that in order to handle a large number of subscribers upon an automatic telephone switchboard it is essential to use a scheme by which several of the switching devices, acting in conjunction, build up the desired connection. The most successful system has employed a system which is a sort of combination multiple and transfer system. A patent for such a system, pending some years, has just been granted to F. A. Lundquist, of Chicago. In this system there are employed "main" and "auxiliary" switching devices. Each line terminates in a main switch in wipers adapted to trail over a set of contact points. These contact points are arranged in groups, there being one group for each 100 lines switchboard capacity. Each contact connects with the wipers of an auxiliary instrument, the corresponding contacts of all of a group of which are in turn multipled together, and each pair of conductors from each of such multipled set is led back to one main switch. Thus, there being 100 contact points in the bank of each auxiliary, there will be capacity to feed back circuits to the main switches of 100 lines. For 1,000 lines capacity there will, therefore, be provided 10 groups of auxiliary switches.

The respective contacts of all main switches are multipled together. Thus each auxiliary switch has one pair of contacts in every main switch.

The general process of building up a circuit is as follows: When the hundreds digit of the number of a desired line is sent in, the wipers of the main switch of the calling line leave their home points and travel to the group of contacts representing the auxiliaries connecting to the desired line. When an idle auxiliary has been automatically selected, impulses are impressed upon it to move its wipers into engagement with the contacts connected to the desired line through the feed back circuit. If the desired line is free the wipers of its main switch will be upon the home or zero points and as it is to these that the feed back circuit extends, the connection will be through to the desired line. If the desired line be calling, the connection will remain open at the main switch home points.

NOVEL TRANSMITTER DIAPHRAGM.

A novel transmitter diaphragm is described in a patent issued to G. W. Talley, of Atlanta, Ill. The foundation of the diaphragm is a fabric of linen or silk, upon one side of which is cemented a thin film of carbon, while on the other is cemented a thin plate of glass, mica or similar substance. Across the back of the diaphragm is fastened a double-tapered, narrow strip of metal, which being in contact with the carbon granules of the transmitter button, serves as a front electrode. It is claimed that a diaphragm of the nature described is far more efficient than the usual metal diaphragm.

CAPILLARY TRANSMITTER.

A rather novel departure in transmitters is one depending for its action upon capillary attraction. In this transmitter the electrodes are closely opposed and the space between them contains a globule of a mobile conducting liquid, which is capable of wetting them, the word wetting being used in its broadest sense. As the electrodes approach the liquid globule spreads out over a larger and larger area, due to capillary attraction, and at the same time the thickness of the film diminishes in the direction in which the current must pass through. The action as the electrodes recede is, of course, the exact reverse. The inventor of this transmitter, E. E. Ries, of New York City, states that the transmission is excellent. The transmitter does not, however, look any too promising from a commercial point of view, because of the presence of the liquid.

SWITCHBOARD SYSTEM.

Mr. Ries has also patented a switchboard circuit system for use with stations having his special receiver. This receiver contains within its shell a mercury globule which serves as a substitute for the hook switch. This necessitates some change in the supervisory and clearing-out signals and this change is provided for in the patent.

TELEPHONE CHAIR.

A most awkward looking piece of apparatus is the telephone chair, invented and patented by G. J. Just, of North Branch, Iowa. Beneath the seat of the chair is arranged the greater part of the apparatus, while from the left arm arises a pedestal upon the top of which a sort of hand microphone is adjustably mounted. The idea seems to be to provide a chair in which one may receive and transmit and have both hands free, and while this undoubtedly is something which must often be accomplished, the apparatus under consideration, at least in its present development seems far too cumbersome.

LETTERS TO THE EDITORS.

A Theory of Gravitation.

To the Editors of Electrical World and Engineer:

SIRS:—In the account in your columns of the very interesting lecture of Prof. W. H. Hallock (page 1055), the lecturer is reported to have expressed himself, in part, as follows: "Sound has long since been properly classed as a particular case of the mechanics of electric matter, * * * and no one doubts that the other outstanding puzzle, gravitation will also fall into this class." In the opinion of the writer gravitation is simply the mechanical effect of wave motion. At any rate, it can be so explained. Picture a longitudinal wave striking a spherical body, and following up the action there taking place, one will find that the result of the force imparted by the wave to the body is a displacement (or pressure) of the latter *toward the origin of the wave.* This statement will, no doubt, seem unjustified to many at first, because we have largely gotten into the habit of thinking of a wave as if it were a moving body, which it is not. It is only a moving force, and hence its mechanical action is different from that of a moving body.

A wave is, as we all know, composed of two parts, the crest and the trough. As its force is lodged in the crest and subtracted from the trough, we might call the former its positive and the latter its negative potential. Both are then equal. But their action is opposite. When the crest of a wave strikes a spherical body its force is largely deflected by the angle of incident presented by the surface. The trough following, being negative, it has nothing to deflect, the sphere gets the benefit of the whole potential in opposite direction and it follows that the result is a displacement—a motion in opposite direction to the motion of the wave. While in all its details the action which takes place is really more complicated, the above may be said to be substantially the sum of it in motion. I submit that this appears to meet the conditions.

I venture the suggestion that it will be found, upon close examination, that waves produced in electric media by the motion of a sphere, may possess the quality of inducing in another sphere not only gravitational, but rotary and orbital motion as well.

PERU, ILL. S. TIDEMAN.

Power Factor Meter.

To the Editors of Electrical World and Engineer:

SIRS:—Among the other interesting matter contained in Mr. Richardson's article on "Power Factor Meters," which appeared in your issue of December 24, I note the following statement:

"All power factor meters on the market are constructed upon the principle of the ratio of wattmeter readings by the two wattmeter methods of measuring power."

The first commercially operative power factor meter was brought out and operated on an entirely different principle, namely, that of the rotary magnetic field; it has thus not been correctly described by Mr. Richardson, and certain inherent features of the "two-wattmeter" type are not found in the "rotary field" type.

Thus, as stated by Mr. Richardson, it is absolutely essential for correct indications with a two-wattmeter type of instrument to have the same power factor in each branch of the polyphase circuit, and to have the circuits balanced. This is due to the fact that such an instrument is, strictly speaking, single-phase in its indications, but requires a polyphase voltage to operate it. In other words, the current from one phase only passes through the series coil, and the polyphase voltage is required for giving co-ordinate fields in known directions

to which the direction of the series or line current is automatically referred.

On the other hand, instruments operating on the rotary field principle, have a current in each current coil in phase with the currents in each of the lines, these currents forming a rotary magnetic field. The voltage coil is connected across one of the phases and thus receives current in phase with the voltage of one phase. The angular position of this voltage with reference to the voltages of the other phases does not vary seriously. The movement carrying the pointer takes a position corresponding to the lag of the resultant rotary field, with respect to the voltage.

Thus, this instrument is strictly a phasemeter instead of a modified wattmeter. An ordinary unbalancing of the load on the phases has practically no effect upon the readings, and thus the instrument may be used on unbalanced polyphase circuits. The instrument measures the average angle of lag of the phases and indicates the cosine of this angle. Although in some cases this is slightly different from the average power factor, the difference is so small as to be negligible.

A complete description of the operation and construction of this Westinghouse instrument appeared in the *Electric Club Journal* for September, 1904.

PITTSBURG, PA. PAUL MACGAHAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Utilizing Magnetic Pull of Dynamos for Adjustment Purposes.—KLASSON.—A note on a case where the air-gap of a 2,400-kw, three-phase generator was adjusted by utilizing the magnetic attraction between stator and rotor. The generator is driven by a horizontal steam engine, and from the very beginning it appears the gap on the steam engine side measured only 0.177 in., while the gap at the opposite side was 0.216 in. In the course of two years the one-sided pull resulting from these conditions had the effect that the bearing brushes (diameter of shaft 19.65 in.) wore away rapidly on one side, and the rotating part shifted 0.03 in. toward the engine. Short-circuits occurred now more and more frequently, and one day it was found that the stator frame had shifted bodily, and that the rotating part touched the stationary part. The generating set was stopped at once, but was required to run again as soon as possible. As the weight of the stationary portion was 51½ tons, and the traveling crane of the station was designed for 25 tons only, it was necessary to find other means for shifting the huge magnet frame. The expedient of shifting it by means of jacks backed against the wall of the station building was considered, but abandoned, as it was feared it would lead to distortions of the frame. It was then decided to utilize the magnetic pull to equalize the air-gap. A one-sided pull was obtained by sending current through one-half of the rotor, the direction of the pull being upward at an angle of 45° to the horizontal. With a current of 80 amp. through the rotor the frame began to move, and, by cautiously varying the current, it was possible to obtain a fine adjustment. The whole adjustment occupied but 1½ hours.—Lond. *Elec.*, December 23.

REFERENCE.

Magnetic Resistance of Air-Gaps.—An English translation, with illustrations, of the German article of Benischke which was recently abstracted in the Digest.—Lond. *Elec. Rev.*, December 16.

POWER.

Electric Power in Collieries.—ROBERTSON.—His presidential address to the Glasgow Section of the British Institute of Electrical Engineers, dealing with the use of electric power in collieries. He believes that just as electricity has in most cases a superiority over compressed air, so alternating current has in many cases a decided superiority over direct current, and that future development will confirm this opinion. He has no doubt that the advantages of this system will be increased when the single-phase series motor is sufficiently perfected to be applied to this class of work. He speaks of some special features of Continental European practice of using electric power in mines. A special feature is the application of electricity for winding coal and men in the main shafts. If these lifts require only motors of moderate size, small compared with the generating units, no serious trouble will arise. However, there are in Germany examples in which the power required for lighting is nearly equal to or in excess of the generating units. In one case the winding motor develops over 1,000 hp at its maximum and this is about double the output of each generator. Although this is only required for very short periods, the effect is that the drop in pressure is very great. The difficulty has been overcome at another colliery where the Ilgner system is in use. This system depends upon the use of a heavy fly-wheel acting as an energy accumulator to carry the motors over the peaks of the winding load. The system consists of a motor supplied with current from the generating station and coupled on the same shaft with a generator of much larger capacity with a heavy fly-wheel between. This secondary generator supplies two motors directly coupled to the winding gear. When these motors are working at their maximum capacity for the short period of winding, they demand the full output of the generator, and as the primary motor coupled to it is insufficient to supply this power, the surplus required is drawn from the energy stored in the revolving fly-wheel. During the periods when the winding drum is at rest, the primary motor again stores up energy by accelerating the fly-wheel, which is again used in the next winding operation. In the example referred to the primary motor is 300 hp, the fly-wheel weighs about 40 tons, the generator gives an output of 1,400 hp and the two winding motors are about 700 hp each. Regulation is done entirely through the field coils of the generator, which is separately excited. While this system appears to have been successful in operation, it is somewhat complicated, and the installation must be expensive. From a statistics, which, however, is not complete, of some 40 or 50 collieries in England and Wales, taken at random, the author finds that the average horse-power of the electric installation is over 400 and cases of over 1,000 hp capacity are not unknown. Another interesting comparison from the same colleries is that while the direct-current system predominates, it only does so to the extent of 55 per cent., against 45 per cent. in the number of collieries, and this is very much reversed when the total horse-power is considered, the figures then being 40 and 60 per cent., respectively.—Lond. *Elec.*, December 2.

Distribution of Electrical Energy.—SNELL.—A paper read before the British Institution of Civil Engineers. The author is of the opinion that the distributing systems which are likely to be adopted in the future are: First, direct-current, two to three-wire, for small districts; second, single-phase, high-tension for railways; third, two-phase, high-tension generation and low-tension distribution, for existing single-phase systems of general supply; fourth, three-phase, high-tension generation and direct-current, low-tension distribution, for existing direct-current systems in large districts, and for railways of short length; fifth, three-phase, high-tension generation and low-tension, three-phase, or six-phase distribution, for entirely new and large districts. By means of diagrams the author demonstrated the economical radii of supply by direct current at 500 volts for different loads transmitted and by the high-tension sub-station method, the result being that above the undermentioned distances the high-tension method is more economical, viz.:

Kilowatts.	Economical radius.
250	1.6 mile
500	1.25 "
1,000	1.06 "

With regard to the effect of storage at sub-stations, the author believes that storage will be more largely resorted to in the future. He then discussed the economical limit of pressure for high-tension supply by underground cables, and gave curves to show that for general purposes, in Great Britain, 6,000 volts is, approximately, the economical pressure. The paper next dealt with the cost of overhead transmission of high-tension currents, and reasons for fixing upon a pressure of 20,000 volts in England are given. The author finally discussed the relative merits of various systems of low-pressure cables for power distribution. He believes that a modification of the present third-rail system will remain with short-distance railways, and that improved methods in the application and control of

single-phase currents will be adopted for long-distance railways.—Lond. *Elec.*, December 2.

REFERENCES.

Steam Engines for Alternators.—HOLTZE.—A long theoretical article on the best design of steam engines for driving alternators working in parallel, with special reference to the question for which design of the engine the weight of the fly-wheel may be made a minimum.—*Elek. Zeit.*, December 15.

Gas Engines.—SAGE.—An illustrated article on governing large gas engines.—*Power*, January.

Electric Power in Printing Office.—An article on the electric equipment of the *Scotsmen* printing office at Edinburgh. Electric power is used exclusively, direct current being employed. The total of the power and lighting installations represents an equivalent of 10,200 lamps of 8 cp.—Lond. *Elec.*, December 2.

Electric Power.—A long illustrated article, giving notes on recent power distribution plants of British manufacturers, including motors, switches and accessories, electric cranes, hoists, rolling mills, power machinery for collieries, miscellaneous applications for electric power, cables and power hoist equipment.—Lond. *Elec.*, December 2.

Power Transmission.—NUNN.—A very profusely illustrated article on pioneer work in high-tension electric power transmission on the system of the Telluride Power Company.—*Cassier's Mag.*, January.

TRACTION.

Single-Phase Traction in England.—A note stating that one of the steam railways to follow the lead of the North Eastern and the Lancashire & Yorkshire in the electric equipment of the line will be the London, Brighton & South Coast Railway. The directors and their consulting engineer, Mr. Philip Dawson, are preparing specifications for the electrical equipment of a trial section. The most important feature of the scheme is the decision to employ an overhead conductor in place of a third rail, and in conjunction with this it is practically certain that a single-phase alternating-current system will be employed. Only a comparatively short length of the line will be equipped at the outset. The experiment is to be made rather with a view to obtain experience on technical matters of design and working than as a test for financial results. It is believed that the overhead wire will be equipped more or less on the principle adopted on the line of railway recently running between Niederschoenweide and Spindlersfeld, near Berlin. In this system two steel suspension wires run the whole length of the track, and the conductor is suspended from them by pairs of wires at about 10-ft. intervals. The line will probably be fed directly at a pressure of about 3,000 volts, single-phase, and each locomotive or motor car will carry a transformer to reduce the pressure sufficiently for a single-phase motor with a commutator.—Lond. *Elec.*, December 23.

Single-Phase Versus Direct-Current Traction in Australia.—An article on a report by Bradford, made for the government of South Australia on the suggested electrification of some suburban lines of Adelaide. The one scheme discussed in the report is a direct-current scheme involving third-rail connection for the greater part, with overhead wires and trolley arm upon public roads, the smaller current requisite at the low speed allowable here rendering a trolley wire supply feasible at 550 volts, even for motor cars rated at 600 hp; the other scheme is a single-phase system with overhead wire at 2,000 volts pressure. The conclusion of the report is in favor of single-phase traction, which is recommended as being the most economical, both in initial cost and in running expenses. The cost of the equipment of the two main suburban lines upon the direct-current system with polyphase transmission is given as $1,345,000, against $1,175,000 for single-phase. In addition, working expenses are higher, owing to cost of sub-station attendance and enhanced up-keep of equipment, the saving upon present working expenses being estimated at $69,000, compared with $75,000 for single-phase. This will pay interest of 4 per cent. on the cost of conversion, and leave a surplus of $31,500, or 2.35 per cent. on the total outlay.—Lond. *Elec.*, December 9.

REFERENCES.

Single-Phase Traction.—An illustrated description of the equipment of the Spindlersfeld single-phase electric railway.—Lond. *Elec. Rev.*, December 16 and 23.

Inverted Rotaries in Tramway System.—An article on the Cricklewood-Hendon-Edgeware branch of the North London tramways. The line consists of about 4½ miles of double track fed from a trolley wire supported by span wires. The interest attaches to the method of feeding the line, which is by means of "inverted rotaries." A sub-station has been erected at Hendon, which is roughly at the center of the line, and this sub-station is being supplied from the Willesden works of the North Metropolitan Power Supply Company. The Willesden electricity works could only offer the choice of continuous current or three-phase current at 25 periods per second. Inverted rotaries were, therefore, installed at the Willesden works to convert the continuous current into three-phase current at 50 periods per second, as used on the other lines of the North London Tramways. The voltage is increased to 10,000 by stationary transformers and the current then transmitted to Hendon by three-core cables and the voltage reduced again to suit the converters. The excitation of the converters at Hendon has been adjusted so that there is unity power factor at approximately three-quarters full load. To start up, the inverted rotaries at Willesden are first run up. The main extra high-tension switch is then closed at Hendon, but the rotary switches there are left open. The rotary is then run up to speed and proper pressure by an induction motor at the end of its shaft, and a light load is placed on one phase of the rotary to steady it. The machine is then synchronized and switched on to the mains, the induction motor being immediately switched off. The synchronizing connections are shown in Fig. 1 and are such that at

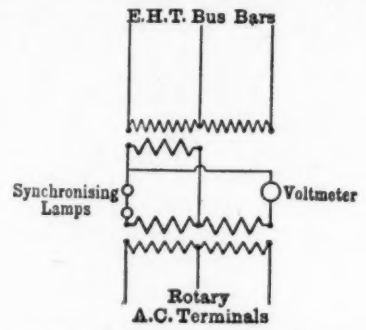


FIG. 1.—SYNCHRONIZING CONNECTIONS.

the moment of synchronizing the lamps are extiguished while the voltmeter shows the pressure of the machine.—Lond. *Elec.*, December 2.

Electric Railways for Grading Work.—An article describing the methods employed in handling the temporary tracks and trolley wires for electric dump cars used in grading waste land. The Brooklyn Rapid Transit Company is disposing of the material from extensive excavations, including that from the tunnels of the Brooklyn section of the New York Rapid Transit Subway in this manner. An organization closely allied with that company has the contract for removing the ashes and general household rubbish, exclusive of garbage, of the city from 13 central collecting stations. These wastes are removed in large steel bins on electrically-driven flat cars, and disposed of in a similar manner, being dumped on low swamp ground from temporary tracks.—*Eng. Record*, December 24.

Energy Consumption of Electric Automobiles.—MÜLLER.—An article pointing out some facts which are often overlooked in considering the energy consumption of electric automobiles. In general, on a solid level road, an electric automobile consumes between 50 and 150 watt-hours per ton-kilometer. If an electric passenger automobile of normal construction runs on level roads with different pavements, one might expect differences in current consumption, according to the well-known tables of traction coefficients. However, it is a fact that the current consumption is the same whatever the pavement as long as the road is level except in very special cases. The reason is that not the road but the rubber tires of the wheels are deformed. Therefore, the deformation of the rubber tires is determining the traction resistance and in comparison with this work the portion which a solid level road of whatever pavement has on the total traction resistance is practically negligible. A second observation is made, when one and the same automobile runs over the same street empty or with one or more passengers; it is often supposed that the increase of current consumption is proportional to the increase of weight. In reality, however, the current consumption remains far behind the increase of weight and with automobiles well provided with springs it is often found that the difference of the current consumption with the empty or loaded automobile is very small. The third point brought out by the author is the unsuitability

of comparing the watthours per ton-kilometer for automobiles of different sizes. For an automobile of given weight there exists a figure for the watt-hours per ton-kilometer below which it is not practicable to go. Thus for automobiles of 1,350 kg. weight this minimum may be 71 watt-hours per ton kilometer, while for lighter automobiles this minimum figure is higher. If, for instance, an automobile of 740 kg. weight consumes 101 watt-hours per ton-kilometer it may be just as well constructed as the other one. The greater the weight of the automobile, the lower may be made the current consumption per ton-kilometer, but this does not mean that heavier automobiles are more economical when only a few passengers are carried, since the total number of watt-hours consumed may be greater for the heavy automobile than for the light one, in spite of the higher specific consumption of the latter.—*Centralblatt f. Accum.*, November 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Current Supply to a Three-Wire Network with one Battery Half.—HOHENEMSER.—In smaller direct-current works a storage battery is used to supply the whole current at times of no load. For dividing the total voltage in order to supply a three-wire system, a battery and a motor-generator are made use of. In cases when one-half of the battery is to be replaced or repaired, it is possible to supply the three-wire network with the other half of the battery alone by the following method, which is shown in Fig. 2: As long as the main

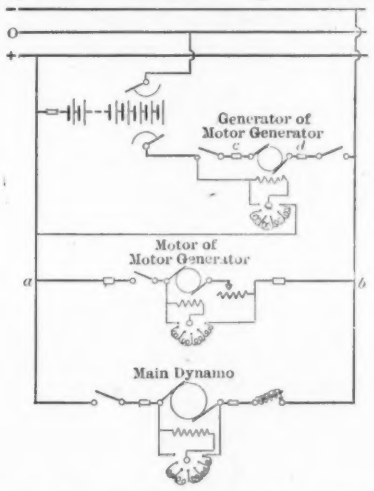


FIG. 2.—THREE-WIRE NETWORK SUPPLY.

dynamo is running it will be seen that the generator half of the motor-generator can replace the half of the battery which is to be repaired. If the main dynamo is gradually disconnected, the system continues to run and any difference of voltage between the two halves of the network can be equalized by shunt regulation of the generator half of the motor-generator. It is also possible to start without the main dynamo by using the connections shown in the figure. In this case the voltage between *a* and *b* equals half the normal voltage betoween the outers. The motor, therefore, begins to run and at once the fully-excited generator half of the motor-generator produces an additional e.m.f., which makes the motor run more quickly until the normal voltage is reached.—*Elek. Zeit.*, December 15.

ELECTRO-PHYSICS AND MAGNETISM.

Photographic Records of N-Rays.—BLONDLOT.—An account of tests intended to place the action of N-rays on an electric spark beyond any doubt. They refer to the arrangement in which a photographic plate is exposed to the action of an electric spark containing N-rays with or without the interposition of a lead screen. The objection that the screen itself might by its capacity increase the brightness of the spark is effectively disposed of by eliminating the N-rays by means of a moist paper screen and showing that then the introduction of the lead screen produces no effect on the photographic record. The more serious objection that the time of exposure might not be quite the same with and without the rays, and might be unconsciously made in favor of a positive result is met as follows: A chronograph is employed to give time signals and to register the times of exposure. The operator counts 25 seconds for each exposure and exposes alternately with and without the rays. The greater impression is invariably associated with the presence of the rays, and the chronograph records show that the exposures are equal to within half a second. For further security, the author then made a practice of always counting an extra second in the absence of the rays. The superiority of the impression in the presence of the rays was still well marked, and the chronograph records showed that the exposure without the rays had been one-half to one-third of a second longer. A similar result is obtained by making two exposures of 50 seconds each. The author claims that these photographic records are the unexceptionable evidence of the existence of the rays.—Lond. *Elec.*, December 9; from *Comptes Rendus*, November 21.

REFERENCES.

Radioactivity.—DADOURIAN.—Measurements of the rate of decay of air-excited activity have given the rate of decay of a combination of the excited activities of radium and thorium. The author has made experiments to see whether the same was the case with the excited activity obtained from underground air. This is indeed the case, although apparently the ground air-excited activity decays at a slightly lower rate than a combination of radium and thorium-excited activities, in the same proportion as they occur in the ground air-excited activity.—*Am. Jour. of Science*, January.

Electric Double Refraction.—ELMEN.—An account of an investigation of electric double refraction in carbon disulphide at low potentials. When light polarized at an angle of 45° to the lines of force is passed through certain dielectrics between two parallel electrodes, they become double refracting. Kerr has given a formula for the difference of phase between the two components of light at right angles and parallel to the lines of force. From the present author's investigation of carbon disulphide there seems to be a decided variation from Kerr's law for low potentials.—*Phys. Rev.*, January.

Bismuth.—CARPINI.—An account of experiments in which the author investigated the change of resistance of bismuth due to small magnetic fields. He finds that for small fields the curve showing the change of the resistance with the magnetic field is a hyperbolic curve. The resistance shows a kind of viscous hysteresis, since the changes of resistance do not follow immediately the changes of the field.—*Phys. Zeit.*, December 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Production of Titanium and Titanium Alloys in the Electric Furnace.—HUPPERTZ.—A very long illustrated account of experiments on the preparation of titanium and titanium alloys from rutile and titanates in the electric furnace. The author first used carbon as reducing agent, but could not get satisfactory results on account of the very high affinity of titanium for nitrogen and carbon. When aluminum is used as a reducing agent, a combination of the aluminothermic method with electric heating yields satisfactory results. The author finally tried an electrolytic method with calcium chloride as electrolyte, the titanium oxide being reduced at the cathode by the calcium set free there. The results were quite satisfactory. If titanates are substituted for titanium oxide, it is possible to obtain by the same method alloys of titanium with iron, copper, etc.—*Metallurgie*, September 8, 22; October 8; November 8 and 22.

Conductivities of Electrolytes in Mixtures of Solvents.—JONES AND CARROLL.—A study of the conductivities of certain electrolytes in water, methyl and ethyl alcohol and in mixtures of these solvents. They studied especially the change of the conductivity with varying proportions of the two solvents in the mixture. They found that in various cases the curve of the conductivity shows a minimum. The explanation of this minimum depends primarily upon the decrease in fluidity which results when the solvents are mixed. The authors propose a hypothesis correlating conductivity, association and viscosity and show that it holds good for all cases available for discussion.—*Am. Chem. Jour.*, December.

REFERENCES.

Formation of Battery Plates.—SCHMIDT-ALTWEGG.—While the formation of storage battery plates by means of perchlorate is known, the present author suggests to use potassium chlorate instead of perchlorate. Positive plates thus formed are said to have a high resistivity against the dangers of discharges to a low voltage.—*Centralblatt f. Accum.*, November 1.

Lead Poisoning.—WERSHOVEN.—An article on the use of "Akremnin" soap for diminishing the dangers of lead poisoning.—*Elek. Anz.*, December 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Ohmmeter.—An illustrated description of the "Megger," which is a combination of an ohmmeter and generator in one case. The gen-

erator is a direct-current magneto machine with a four-coil armature and a commutator formed of two divided discs, two pairs of narrow grooved wheels taking the place of brushes. Roller bearings are employed. The ohmmeter is a dead-beat moving coil instrument, and, as seen in Fig. 3, the same pair of permanent magnets (which are magnetized to about 2,000 lines per square centimeter) are employed for the magneto-generator and ohmmeter. The current and pressure

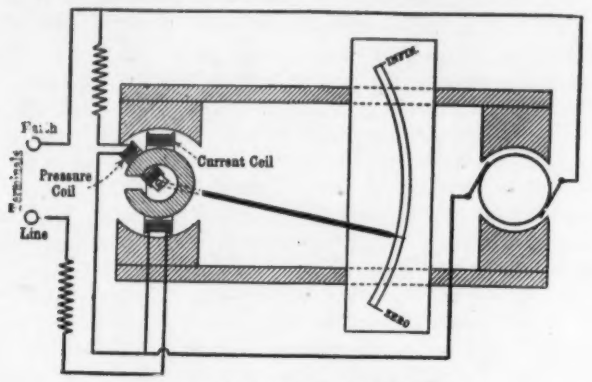


FIG. 3.—DIAGRAM OF OHMMETER.

coils are free to rotate in this field, and are wound at an angle slightly less than a right angle, the current coil being in the most intense part of the field. The pressure coil will take up the position seen in Fig. 4 when there is "infinite" resistance in circuit with the series coil, and when there is a current through the series coil the latter will have an opposing torque, so that the moving system

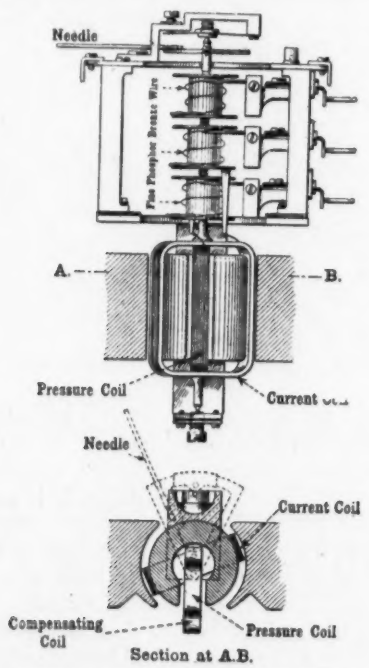


FIG. 4.—SECTIONS OF OHMMETER.

rotates, the angle made with the "infinity" position being a function of the resistance in circuit with the series coil and being independent of the voltage of the generator. The pressure coil extends from the center to one side of the cylindrical magnet keeper, and not right across, as does the current coil. In order to protect it from the influence of external fields a compensating coil is added outside the pressure coil, and is connected in series with it. Particularly fine wire is necessary for leading the current into the moving coils.—Lond. *Elec.*, December 9.

REFERENCES.

Iron in Alternating-Current Instruments.—SUMPNER.—Continuation and conclusion of the article, the first part of which was abstracted in the Digest, December 31. He describes several types of wattmeters which he has built with iron. His object is to show that the errors arising from using iron magnetic circuits in wattmeters are not necessarily greater than those involved in the use of transformers in such instruments. There is an appendix giving mathematical notes on the action of a rotating magnetic field on a coil conveying an alternating current, and free to rotate about the same axis as the field; on wattmeter errors, and on wattmeters having iron-cored electromagnets.—Lond. *Elec.*, December 2 and 9.

Meters.—An illustrated description of several new electric meters, made by English companies, including a pre-payment meter and maximum demand indicator operating on the electromagnetic principle and several ampere-hour and watt-hour meters. One company makes a modification of their ampere-hour meter to record correctly the actual energy consumed on the circuit of varying pressure, such as that of a tramway system; for this purpose the permanent magnet-driving field is replaced by an electromagnet, while the permanent magnet is still retained for the brake.—Lond. *Elec.*, December 9.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Charging of a Cable Through a Condenser and Resistance.—HEAVISIDE.—A mathematical article, with reference to a recent article of Gaye on this problem. The object of the article is "to promote the study of special cases numerically and graphically, especially as regards the inclusion of the self-induction of the cable, which is by no means a negligible quantity even now, while it ought to be a paramount agent. If it is love that makes the world go round, it is self-induction that makes electromagnetic waves go round the world." Since the article is highly mathematical, it cannot be abstracted.—Lond. *Elec.*, December 23.

Telegraph Wires as Return Circuits for Signal Lines.—BRASCH.—In a case in which the electric signal devices and the lines were in good order, great troubles were experienced due to the change in the transition resistance of the earth plates, the earth being used for the return circuit of the signal line. This transition resistance depended greatly on the weather. The difficulty was overcome by using telegraph wires for the return circuit with excellent success, the telegraphic communication being not disturbed at all.—*Elek. Zeit.*, December 8.

MISCELLANEOUS.

Training of the Electrical Engineer.—L. BELL.—A discussion of the problem in which the author expresses, among others, the following opinions: The student who starts in electrical engineering to-day must make up his mind to a long, steady pull to gain a vantage ground, and an unceasing fight to maintain it. The first thing is to get as thorough a general training as time and means permit. The common tendency is to train men for factory engineering rather than for the broader field of outside work. Yet for every man required in the design and testing of electrical machinery a score are needed to install and operate his output, and the earning capacity of the installing and operating force, man for man, is quite as great as that of the construction force. A technical graduate has to learn many things before he settles down to his bearings in practical engineering, and the very best thing that can be done for him is to give him the power of quickly grasping his environment, whether that chances to be in the factory or the field. Two other qualities, the successful engineer must have pre-eminently—initiative and resourcefulness—and these have a more definite connection with the character and scope of his training. The former demands a strong and certain grasp of fundamental principles and methods, while the latter requires, in addition, a wide acquaintance with phenomena. Our present division of secondary and collegiate education is artificial and by no means well suited to secure the greatest good for the greatest number. A subsidiary technical school, taking students, say, from sixteen to twenty years of age, and preparing them to enter the technical arts or to go on into advanced engineering studies, would have a great practical value. If the student could come up from a higher secondary school with English studies, draughting and shop practice well in hand, his professional course could be laid out to far greater advantage than at present. One may frankly admit that an adequate technical training cannot be gained in four years of study, starting from the usual point, and may add provision for two or more years of post-graduate study. But the existence of a post-graduate course does not excuse mismanagement of the undergraduate course, which ought to be planned for the greatest good of the greatest number. Engineering education, like engineering itself, is necessarily a series of compromises. Its two great branches—mathematical theory and laboratory practice—have a strong tendency to diverge, and some freedom of action in each must be sacrificed in order to keep them together. The engineering habit of mind can be cultivated by hard work on problems which involve arbitrary limitations of various sorts, and these are of immense value in gaining initiative. There

is a real necessity for minor thesis work all the time.—*Cassier's Mag.*, January.

REFERENCES.

Engineering Mathematics.—GOULD.—An article, illustrated by some mathematical examples, worked out. The author endeavors to establish two facts: First, that mathematics lies at the bottom of all scientific engineering; that it is an indispensable part of the accomplished engineer's equipment; second, that the mathematics of the engineer is a different thing from that of the astronomer or the professor. In certain branches, for instance, bridge engineering, the difference is less marked, although it is still there; but in most cases the product which the engineer receives from the professor requires to be worked over by him before he can use it handy in his business. —*Cassier's Mag.*, January.

Imports and Exports from France.—LOUISVILLE.—Statistical notes on the imports and exports of arc lamps, arc lamp carbons and storage batteries to and from France. It appears that the United States has had practically no trade in these articles with France in recent years.—*L'Industrie Elec.*, November 25.

Selenium.—RUHMER.—A long illustrated paper read before the Berlin Electrical Society on selenium and its applications in electrical engineering and especially in light telephony.—*Elek. Zeit.*, December 1.

American Society of Mechanical Engineers.—An account of the recent annual meeting of this society, with abstracts of the papers presented; among them Bowie, on centrifugal fans; Main, on the value of water powers; Bunnell, on the power plant of the tall office building (see Digest, December 24); Sargent, on an indicating steam meter; Moss, on the inertia effect of the connecting rod; Benjamin, on the bursting of fly-wheels; Rockwood, on condensers for steam turbines; Dean, on fire-tube boilers; Stanwood, on losses in non-condensing engines; Lucke, on pressures and temperatures in free expansion; Hale, on staybolts, braces and flat surfaces, a discussion of the various rules and formulas; Bement, on a bad case of discharge of water with steam from water-tube boilers.—*Power*, January.

BOOK REVIEWS.

L'INDUSTRIE AURIFERE AU TRANSVAAL. By Albert Michaut. Paris: A. Lahure. 156 pages. Price, 5 francs.

This volume, indicated by the above, is a study of the past financial and mining history of the gold mines of Transvaal and some views of possible future industrial development there. It is written principally for imparting information to the investor. As all the deep mining on the Rand can only be done by the aid of electrical transmission of power, this book may prove of interest to the American electrical engineer.

THE ELECTRIC FURNACE. By Henri Moissan. Easton, Pa.: Chemical Publishing Company. 305 pages. Price, $3.00.

The author was one of the first to realize the importance of the electric furnace as a research apparatus. By its means he helped to develop the field of high temperature processes. It is unnecessary to state that no experimental work in chemistry has been more fruitful of results except that work done in studying radioactive bodies. A mass of experimental data about the formation of the diamond, borides, carbides, silicides, etc., of the metal is given in elaborate detail.

The instruments now placed in the hands of the chemical investigator are so powerful a lever that prediction as to future results is but fraught with chance. In industrial lines of work the electric furnace, we are glad to state, is just beginning to show its possibilities. Thus for both the theorist and the practical man (which two are coming nearer together) this book is valuable. The translation is the work of Prof. V. Lehner, of the University of Wisconsin.

BOOKS RECEIVED.

EXPERIMENTELLE ELEKTRIZITATSLEHRE. By H. Starke. Leipzig: B. G. Teubner. 422 pages, 275 illustrations. Price, 4 marks.

MATHEMATISCHE EINFUHRING IN DIE ELEKTRONENTHEORIE. By A. H. Bucherer. Leipzig: B. G. Teubner. 148 pages, 14 illustrations. Price, 3.20 marks.

THEORIE DER ELEKTRIZITAT. By M. Abraham and A. Foppl. Vol. I. 1: Einfuhrung in die Maxwellsche Theorie der Elektrizitat. By A. Foppl. Second edition. Leipzig: B. G. Teubner. 443 pages, 1 illustration.

DIE DARSTELLUNG DES ZINKS. By Emil Gunther. Halle: Wilhelm Knapp. 243 pages, 59 illustrations. Price, 10 marks.

JAHRBUCH DER ELEKTROCHEMIE. By Dr. Heinrich Danneel. Halle: Wilhelm Knapp. 750 pages, 137 illustrations. Price, 24 marks.

DIE ELEKTROLYTISCHE RAFFINATION DES KUPFERS. By Titus Ulke. Halle: Wilhelm Knapp. 150 pages, 86 illustrations. Price, 8 marks.

KUNSTLICHER GRAPHIT. By Francis A. J. Fitz-Gerald. Halle: Wilhelm Knapp. 60 pages, 14 illustrations. Price, 3 marks.

DIE GALVANOPLASTIK. By Dr. W. Pfanhauser. Halle: Wilhelm Knapp. 137 pages, 35 illustrations. Price, 4 marks.

DAMPFTURBINE. By Gabriel Zahikjanz. Berlin: Bickel & Co. 24 pages.

TRANSVERSAL DAMPFTURBINEN. By A. Patschke. Mulheim: Max Roder. 73 pages, sixteen plates in pocket. Price, 2.50 marks.

DIE DAMPFTURBINEN. By Hans Wagner. Hannover: Gebruder Janecke. 146 pages, 150 illustrations. Price, 8 marks.

ELEKTROLYTISCHES VERFAHREN ZUR HERSTELLUNG PARABOLISCHER SPIEGEL. By Sherard Cowper-Coles. Halle: Wilhelm Knapp. 17 pages, 13 illustrations. Price, 1 mark.

LES ACCUMULATEURS ELECTRIQUES. By L. Jumau. Paris: V. Ch. Dunod. 926 pages, 594 illustrations. Price, 27.50 francs.

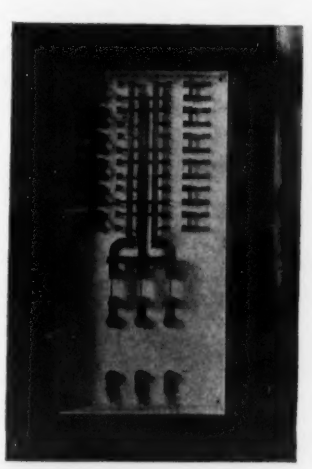
Switch and Panel Board Engineering.

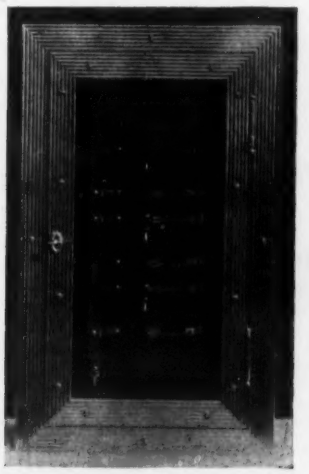
BY B. B. HATCH.

It must be understood that the term switchboard engineering does not apply to large central stations alone, but to the small station, the isolated plant and to the individual uses of electricity in any form. Many stations and plants to-day have more capital invested in switchboards alone than was represented in the entire original cost of the plant, and it is generally acknowledged that the investment is a profitable one.

The development of the switchboard has also been followed by a corresponding and no less important improvement in the line of small boards at centers of distribution and panelboards in place of the time-honored cut-outs and fuse mounts.

Recognizing the shortcomings of the various types of cut-outs and fuse mounts, especially when applied to an up-to-date installation,





FIGS. 1 AND 2.—PANEL BOARDS.

switchboard engineers have lately given much attention to the construction of panelboards designed to act as mounts for the standard types of fuses and as centers of distribution, and these efforts have been taken up and developed by many of the switchboard manufacturers, until to-day the panelboard has reached such a state of perfection that very few first-class installations are made without them.

Fig. 1 illustrates a large panelboard recently installed at the Charlestown Navy Yard. This board is of the "center of distribution" class, and is enclosed in a non-combustible case with architrave and door frames of heavy brass mouldings. The door panels are of

the best grade of beveled plate glass, the whole combining to make a most effective and up-to-date piece of engineering.

Fig. 2 illustrates a smaller board used as a center of distribution in a machine shop. This board, while of less expensive construction, has the same excellent features as the larger board.

Fig. 3 conveys an excellent idea of standard forms of panelboards and cabinets which may be obtained at short notice, thus making it possible for the contractor to place the cabinets in the building at the beginning of the work, which is a very desirable feature, inasmuch as it insures a proper location and arrangement of the conduits at the beginning. All of the above boards were made by the W. S. Hill Electric Company, New Bedford, Mass.

In connection with the development of panelboards and fuses, it is worthy of note that after twenty-five years of steady development in every branch of the electrical business, the device most generally

FIG. 3.—PANEL BOARDS.

accepted for protecting small branch circuits and much used on small panelboards, is the Edison fuse plug, and this plug is to-day practically the same as used by Edison in his initial installations.

Circuits of larger capacity which were formerly protected by open fuses are now equipped with non-arcing fuses of the enclosed type, which are readily mounted on the panelboards, together with the plug fuses and other devices, making a neat and convenient arrangement in much more compact form. It is by this flexibility of arrangement and thoroughly electrical and mechanical excellence that the modern panelboard has won its place.

Mercury Tubes in a Newspaper Pressroom.

One of the most recent additions to the marvels of the metropolis is the new building of the New York *Times*, at Forty-second Street and Broadway. It has an extreme height of 476 ft., and is intended in part for office purposes, but a large portion will be employed for the work of the newspaper itself. The following is a brief summary of the electrical equipment of the building, which contains 21 miles of conduit and 74 miles of wire, and will draw, it is said, not less than 1,000 kw-hours daily from the mains of the New York Edison Company, it having been decided quite early not to put in an isolated plant. The electrical equipment is enumerated below:

One hundred and eleven motors of different makes, Crocker-Wheeler, Sprague, etc.; 4 Hoe octuple presses; 1 press, job; 1 press, electric proof; 8 Kohler safety devices for controlling press movements; 2 autoplates, turning out eight stereoplates per minute; 38 linotypes; 3 pumps, house; 3 pumps, sewage; 1 pump, air compression, for pneumatic tubes; 1 pump, air vacuum for cleaning carpets and offices; 1 pump, ink; 1 paper conveyor, for carrying printed papers from presses to delivery room; 7 elevators, passenger and lift; 4 Leonard system of control for elevators; 1 gallery lift; 8 trolley hoists for paper rolls; 8 fans for metal pots and for ventilating press room; 6 gymnasium; 1 machine shop lathe; 1 machine

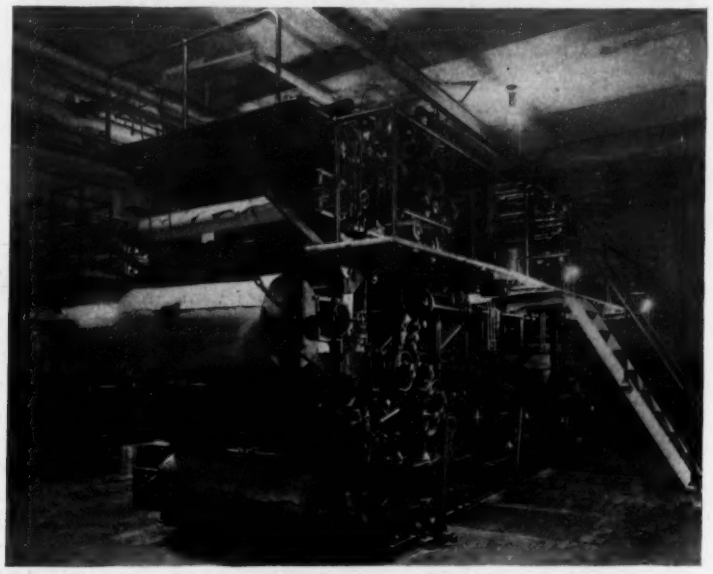


FIG. 1.—MERCURY VAPOR LAMPS IN "TIMES" PRESS ROOM.

shop lathe; 1 stereo molding machine; 5 stereo tail cutter, round; 1 stereo shaver, round; 1 stereo router; 1 stereo shaver, flat; 1 stereo trimmer, flat; 1 stereo saw; 1 stereo jig and drill machine; 3 refrigeration.

Light—4,000 incandescent, 15 arc, 42 Cooper Hewitt lamps, search, signs, bulletin service, elevator flash, cigar lighters, carriage call.

Heat—Stereo matrix; restaurant, including plate warmers, coffee

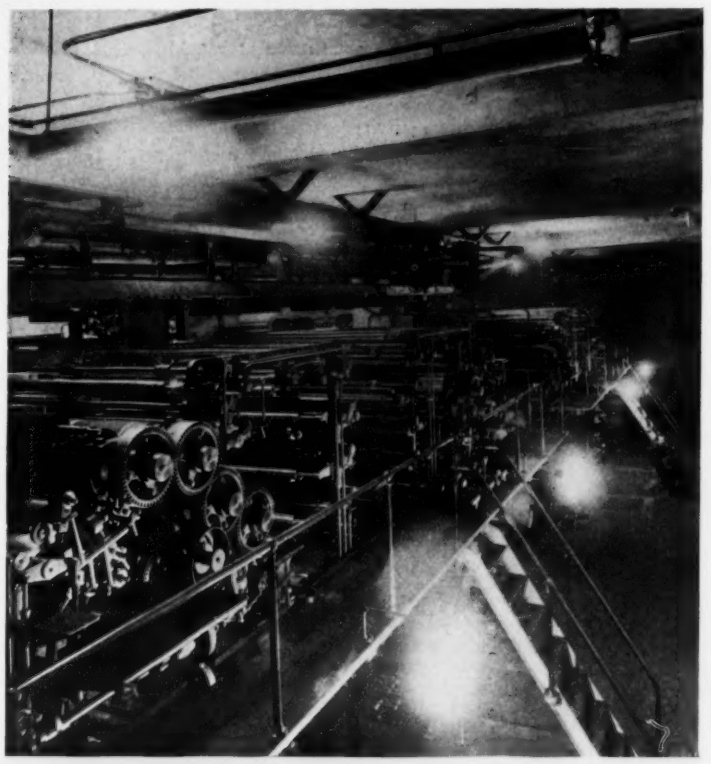


FIG. 2.—MERCURY VAPOR LAMPS IN "TIMES" PRESS ROOM.

urns, tea kettles, egg boilers, griddles, self-dumping oyster cooker for stews, toasters; stereo pastepot; soldering irons; hair curler for ladies' toilet; heating pads; heating tailors' irons. This is all largely of Hadaway design.

Miscellaneous—Time clock connection, fire alarm connection, telegraph connection, telephone connection, messenger call connection, office call connection.

Practically all of these features have been described to our readers already, but emphasis may be laid, deservedly, on the remarkable manner in which the composing room and the pressroom are illuminated. The Cooper Hewitt mercury tubes are employed in both places, and the unusual color of the light in the composing room at the top of the building catches the eye from any quarter of the city. There are 12 such lamps in that department, and for the make-up tables they are considered by those who have worked under them very satisfactory, giving a cool, soft light, not unlike that of daylight. With regard to the typesetting machinery, etc., as the light casts no shadow, the type can be seen from any position. New type also can be easily read as it has a dull appearance and casts no reflection. There are also 4 tubes in the mailing department.

The presses are no less than 55 ft. below the street surface and

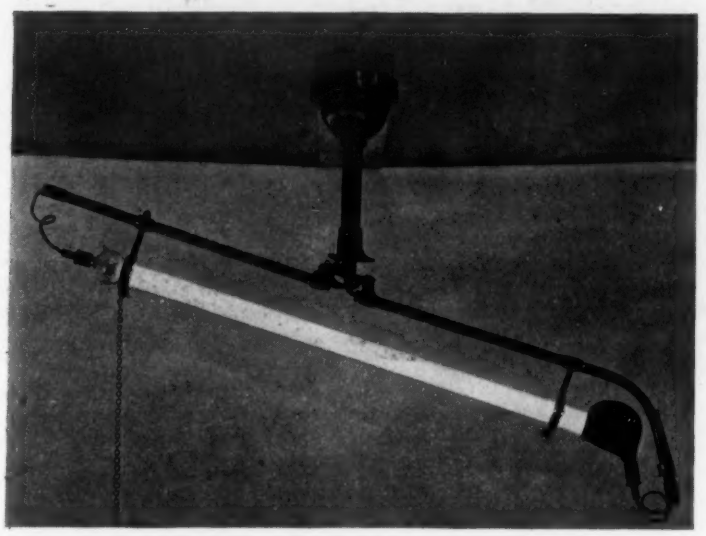


FIG. 3.—ONE OF THE 42 COOPER HEWITT LAMPS IN "TIMES" BUILDING.

the equipment is such that 144,000 sixteen-page papers can now be turned out in an hour, while an ultimate capacity of 432,000 can be provided. In the press and steretotype rooms, 26 Cooper Hewitt lamps are installed lighting four double, quadruple, octuple presses and two autoplate machines. These tubes take the places of outlets for 132 incandescent lamps and 14 arcs, consuming also but one-third of the current. They light the four presses thoroughly, as well as the area of 17,000 sq. ft. of floor space with a ceiling 21 ft. high. We have been interested to note in studying this equipment how the disadvantages of wiring around presses are obviated, as they are thoroughly well lighted by reflection. These and the other lamps, 42 in all, are of the H-6 type herewith illustrated, and are operated two in multiple at 118 volts, off the Edison mains, as shown by the diagram. Each pair takes 3.5 amp. Reference has been made to the economy effected in current. The original estimate for current with arcs and incandescents was 15 kw. The Cooper Hewitt outfit takes

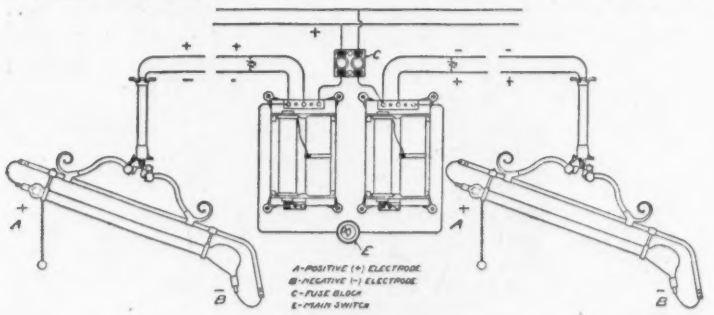


FIG. 4.—DIAGRAM OF LAMP CIRCUITS.

5.46 kw. Another point as to economy occurs in regard to the installation, the expense for which was greatly reduced. Had incandescents been used it would have necessitated boring about 1,600 holes in the press frames.

The type of tubes used herewith, taking 3.5 amp. per pair, have for 109-125-volt circuits a light-giving length of 20¾ in. and a total tube length overall of 27¼ in. The diameter of the tube is one inch and the length of the suspension bar varies from 3 in. to 4 ft. With only a 3-in. suspension bar, the lower end of the lamp is 15 in. from the ceiling.

Triumph Variable-Speed Motor.

The Triumph Electric Company, Cincinnati, Ohio, is placing on the market a motor especially designed to meet the requirements of a variable-speed motor for application to machine tools, or any other line of machinery where a motor can be applied. When it was decided to make such a motor a drawing of it was submitted to the leading tool manufacturers throughout the country for their opinion with respect to their requirements, to the end that a motor should be produced that could be easily applied to the tools of the leading manufacturers. Aside from the variable-speed feature, it was also desired to include not only compactness, but also simplicity of construction and light weight. Other points were that it should be of

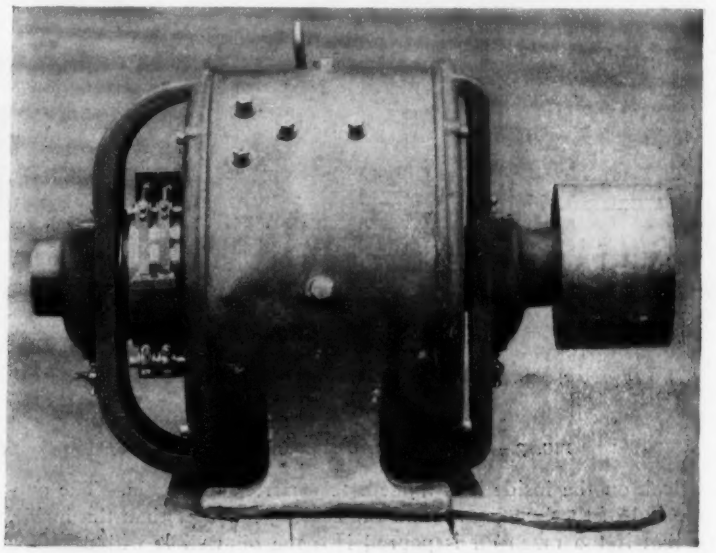


FIG. 1.—VARIABLE-SPEED MOTOR.

the universal type, so that it could be mounted either in a vertical, horizontal or inverted position, be capable of withstanding heavy overloads and sudden fluctuations of load without any injury whatever, and require but little, if any attention. While the motor was, as stated above, especially designed for variable-speed purposes and for application to individual motor drive, at the same time, it is equally adapted for constant speed and for standard belted purposes, or in other words for the work of any ordinary motor.

As will be seen from the accompanying sectional drawings and

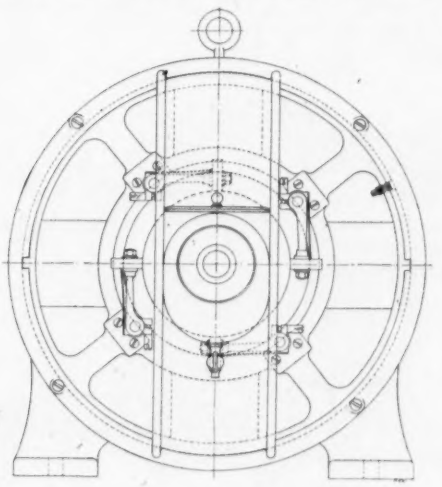


FIG. 2.—END ELEVATION OF MOTOR.

photograph, the construction is of the simplest character. The frame or pole ring has been reduced to the smallest possible dimensions by the use of the highest grade of magnetic steel. The steel pole pieces are cast solidly with the pole frame. The pole tip or shoe is of laminated construction and bolted solidly to the pole piece.

Since the length of the motor was to be as short as possible, in designing the bearings they were made to extend on one end under the winding, and on the other end under the commutator. This makes an extremely compact motor, while at the same time permitting of the use of quite a large armature.

It will be observed that the brush rigging is carried next to the crown, which was decided upon for two reasons: First, it permitted of the use of a very rigid short bracket, and second, it eliminated any possibility of oil leaking along the shaft and out on the brush holders, which is a common occurrence in the case of motors on which the brush rigging or brush yoke is carried on the pedestal...

An oil bell is provided to protect the commutator from oil. The commutator shell is ventilated in such a manner that the oil is prevented from following the air and injuring the windings, ventilating ducts radiating from the center outward. There is an opening at the bottom of the brackets which carry the bearings, so that should any

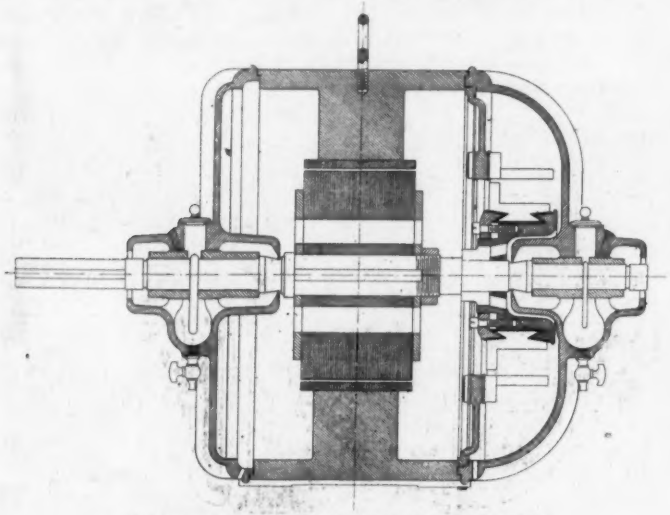


FIG. 3.—LONGITUDINAL SECTION OF MOTOR.

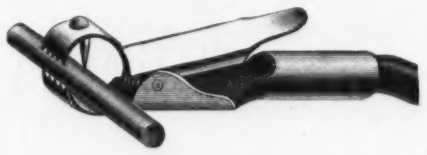
oil leak on the inside it is immediately carried out again. The outside end of the housing around the bearing is larger than the inside, so that if too much oil is poured into the oil well it will overflow outside of the armature, or in other words will run over the outside of the housing.

The armatures are the iron-clad laminated construction with coil-wound windings. The commutators are of hard-drawn copper or of drop forgings and the field windings are also wound on forms. The brushes are of carbon, carrying not over 30 amperes to the square inch.

For variable speed, field resistance or field control is employed, whereby the efficiency is always of the very highest and the horse-power maintained over the full range of speed. In some instances these motors have been made for a variation in speed as high as 6 to 1; common practice, however, and what meets the average requirement, is a variation of 2 and 3 to 1.

Testing Clips.

A handy device for securing temporary connection with insulated telephone and telegraph wires for testing purposes is shown in the accompanying illustration. It consists of a snap having serrated jaws to secure a firm grip upon the insulation, and a pin for the purpose of piercing the insulation and thus obtain contact with the wire. It is evident that when the point of the pin touches the wire



TESTING CLIP.

the entire metallic framework of the clip is in electrical connection with the conductor. The leading-off wire from the clip gives the necessary connection with the testing instrument.

The use of this simple device obviates the necessity of stripping wires of insulation and thereby saves much time in making tests. It is stated to be used very extensively in large telephone exchanges and in telegraph offices.

This clip is manufactured by the Frankel Display Fixture Company, 718 Broadway, New York City.

Sparking Coils for Automobiles.

The rapid development of the hydrocarbon automobile industry has, as our readers are aware, given a great stimulus to the improvement and perfection of ignition devices for the explosion of the charge in the cylinders. While we believe some types of gasoline engines in this field still depend upon hot tube ignition, the vast majority, as the coming show next week at Madison Square Garden will demonstrate, are designed for some form of electric sparking device. The production of the spark depends, of course, upon a source of current, such as a primary battery, a secondary battery,

FIG. 1.—SPARKING COILS.

a small dynamo or a magneto generator, and the current thus furnished is employed to produce the spark, either from the primary or the secondary circuit. The dry cell has found an enormous vogue and popularity in this class of work. Where the primary circuit is depended upon, the ordinary reaction coil suffices, furnishing a low-tension spark with either a wiping or a breaking contact. In the

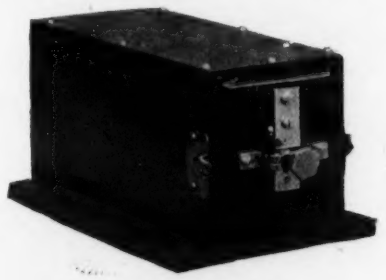


FIG. 2.—SPARKING COIL.

case of the secondary circuit, we have the more refined types of induction coil furnishing a high-tension spark between the slightly separated terminal platinum points. The "jump spark" from the induction coil is a popular form of ignition and a great deal of ingenious work has been bestowed upon the problems connected with

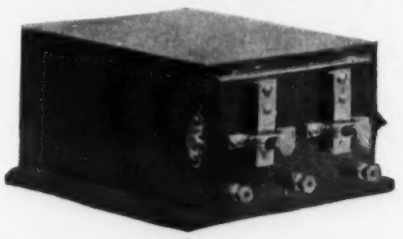


FIG. 3.—DOUBLE DASHBOARD COIL.

its efficient and instantaneous production, as well as upon continuity of operation under all the trying ordeals to which an automobile may be and often is subjected.

One of the enterprising electrical concerns giving special attention to this subject is the New York Coil Company, of 52 Park Place, New York City, whose "Fire Ball" jump spark coils have already made a reputation for themselves. Their water-proof primary spark coils for "make-and-break" or "wipe-spark" ignition are already well known to the trade, and the company are now introducing a remark-

able line of coils of the induction type intended specifically for automobile work and to be placed on the dashboard of the machine.

We are able to illustrate some of these types herewith. Fig. 1 is the single vibrator coil type and is shown associated with the Roche Standard dry battery, whose durability and longevity have already been so well tested by the naval and military services, as well as in launch and other work. Fig. 2 shows the single dashboard coil; Fig. 3 the double dashboard coil, and Fig. 4 the quadruple type.

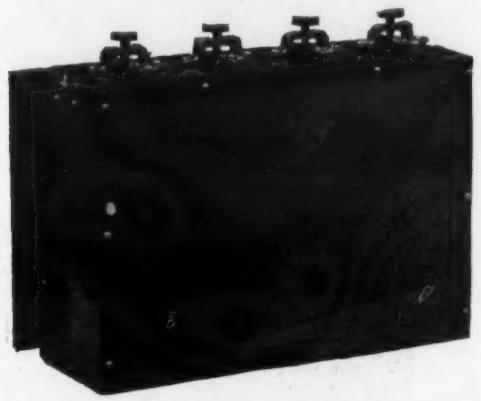


FIG. 4.—QUADRUPLE SPARKING COIL.

Fig. 5 shows the double dashboard type with the cover removed. By means of the use of the very best materials in construction and improved methods of insulation, these coils give a very hot, fat spark with a minimum consumption of current, and what is probably of more account, in increasing the capacity and output of the gasoline engine, the coils are extremely speedy in action. The high insulation of these coils is gained by abandoning methods heretofore used in spark coil construction. The company uses the highest grade of insulating compound between every turn and layer of wire, instead of silk or cotton-insulated wire, which leaves an air space between. As a result of such novel and improved construction it seems impossible to break the coils down, even although the secondary circuit be opened while operating the coil. There is no wear whatever except at the platinum points, which are of peculiarly hard platino-iridium. The binding posts on the dashboard coils are enclosed in a separate chamber, either in the bottom or front of the box, and the wood is

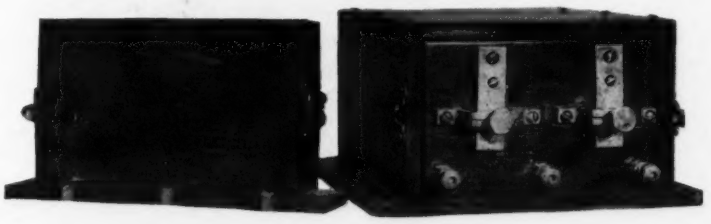
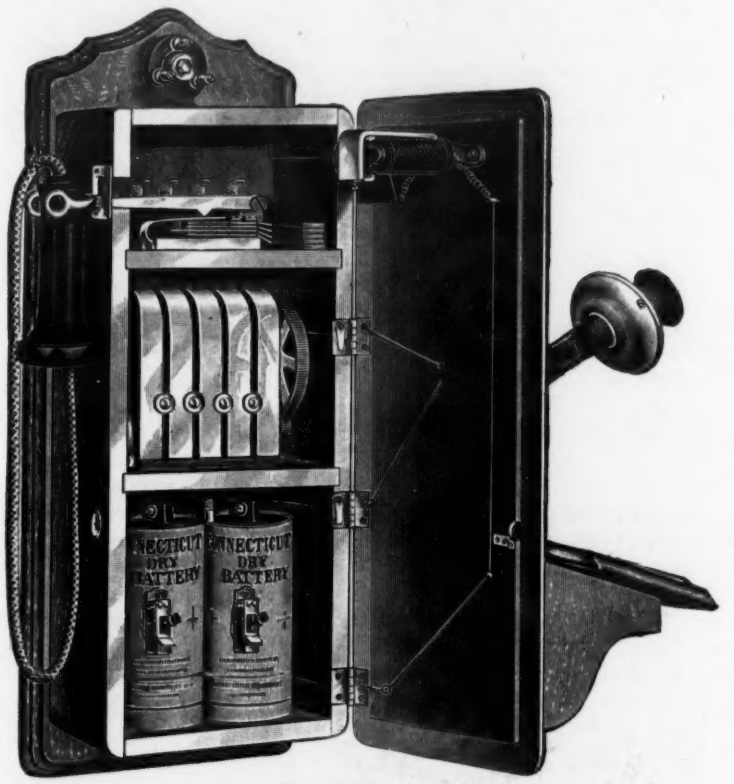


FIG. 5.—COIL WITH COVER REMOVED.

all shellacked and moisture-proof. The box cases are made in all styles of wood finish, and, like the other parts of the mechanism, exhibit the utmost care on the part of the manufacturer to insure durability and water-proof qualities. As electrical people who use induction coils are well aware, such apparatus is peculiarly sensitive, and insulation will break down in a most unexpected manner at critical moments. In these coils, however, owing to the quality of material, the conscientious work put upon their manufacture, and the careful preliminary testing under all presumable conditions, these coils mounted on leading automobiles have given most satisfactory results and have already been used considerably and with great success in launches. Visitors to the Automobile Show during the coming week will find it of interest to visit the exhibit and to see these automobile coils under test.

Non-interfering Telephones.

The Connecticut Telephone & Electric Company, of Meriden, Conn., has placed upon the market a heavy bridging telephone equipped with its new non-interfering ringing device. This device will be especially appreciated for heavily loaded bridging lines. One of the greatest difficulties with country lines is the inability to ring the subscriber when one or more receivers are off the hook. This is due to the inquisitive habits of people listening in on the same line. When the receivers of the telephones are removed it is impossible to ring past this point. This limits the service and forms one of the greatest difficulties of rural lines. The Connecticut company attaches this device inside the telephone and it is also sold separately. A local system can equip a line with 30 of these bridging non-interfering

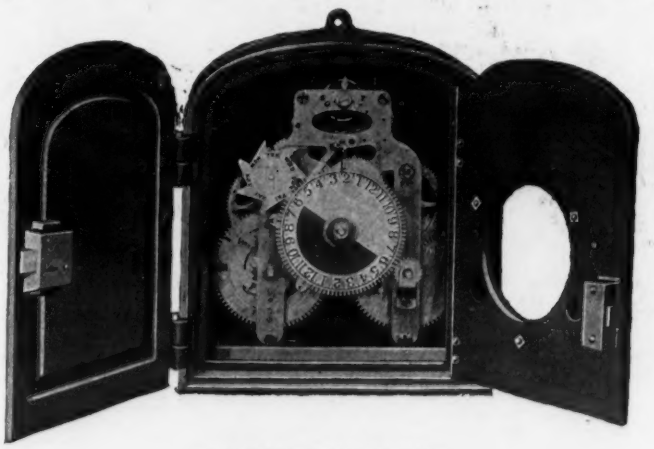


NON-INTERFERING TELEPHONE.

telephones and ring the thirtieth telephone with 29 receivers off the hook. Of course it will be understood that in order to make a thorough test of this device, practically all of the telephones on the line must be equipped.

Automatic Time Switches.

Two new types of automatic switches have been put on the market by the Hartford Time Switch Company. The first model is known as type "B," and is claimed to have fully demonstrated its reliability



AUTOMATIC TIME SWITCH.

to work continuously and successfully under all conditions, in the varying temperatures of summer and winter, and in protected and unprotected positions, by the greatest of all tests—long service in actual operation. Type "C," one of the new models, has been put out to meet the demand for a switch that would automatically omit throwing the switch on Sunday, without in any way interfering with its regular operation on week days. This switch is not complicated and when set up requires no more attention than the type "B" switch.

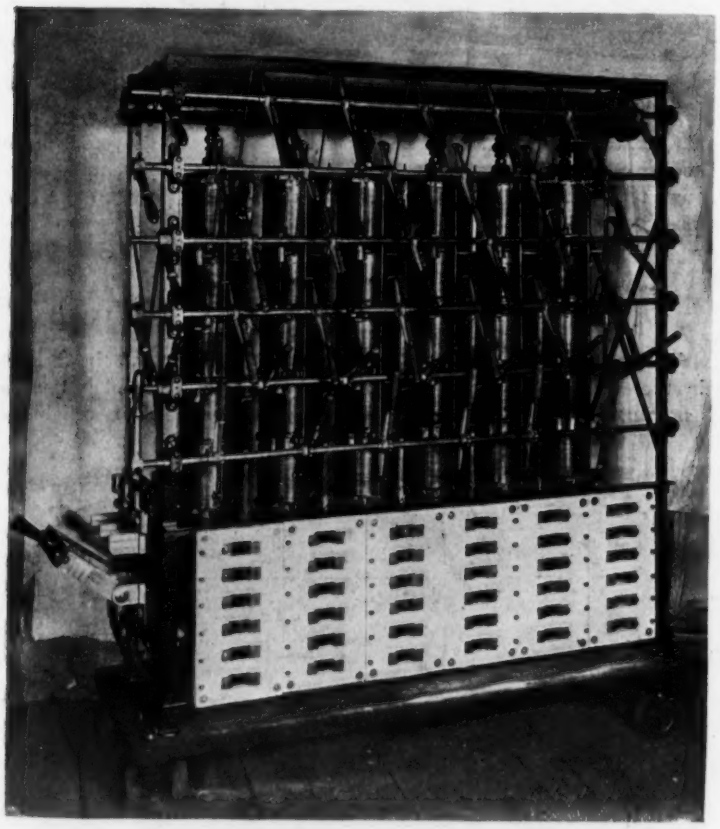
The type "D" switch was designed particularly for controlling

window and sign lighting on thoroughfares which have crowds at certain regular periods daily, such as streets in the vicinity of theatres, and those leading to railroad stations with suburban traffic before and after the theatre. This switch throws the current on for two periods each day, and, for example, can be set to light windows and signs from 5 to 8.30 p.m. and again from 10 to 12 p.m., or at such other hours as the user may desire. It gives the maximum of useful display lighting with the minimum of expense. This switch can be furnished combined with the automatic cut-out feature of type "C."

All switches are equipped with a high-grade Seth Thomas marine clock movement. The switch is of the rotary type having double contacts of ample capacity and thoroughly insulated. The entire mechanism is enclosed in a japanned iron case with double doors, and is dust and weather-proof. The sub-treasury lock used on the outer door prevents any unauthorized tampering with the mechanism. All switches are furnished wired and ready for immediate installation. Mr. A. Hall Berry, 97 Warren Street, New York City, is sole sales agent.

Theatre Dimmer.

The accompanying illustration shows an "Ajax," portable, combined switchboard and dimmer, recently installed in the "Ye Liberty Playhouse," Oakland, Cal., by the Universal Electrical Works, of San Francisco. The apparatus is the invention of O. C. Grindell and claimed to be the smallest, lightest and most compact theatre dimmer or rheostat made, having a capacity of 3,000 lights (36 sets of from 75 to 90 lights each), and taking up but 5 ft. 9 in. by 6 ft. by 18 in. It is worked entirely independent of any switchboard, as it controls



PORTABLE DIMMER.

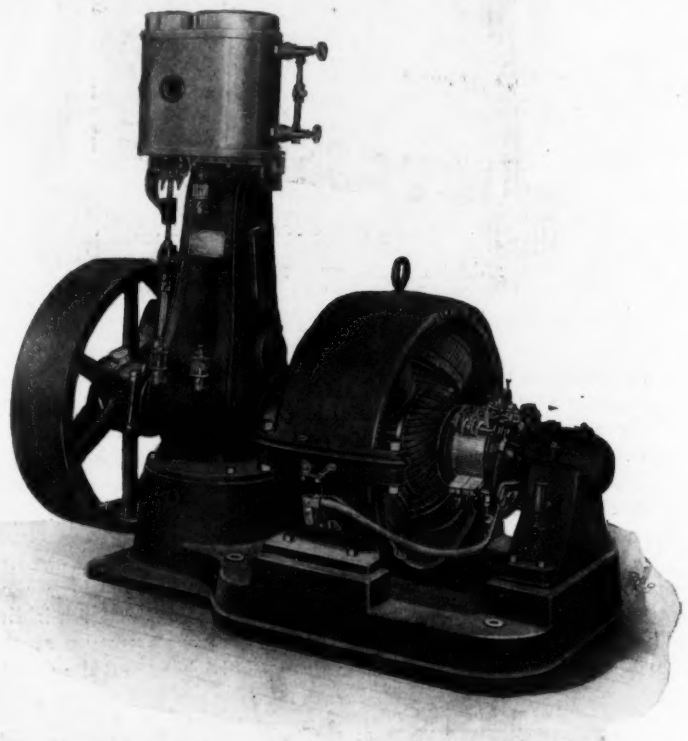
the lights perfectly and entirely, thus doing away with and taking up no more room than the ordinary switchboard alone. This dimmer can be made with from 60 to 250 steps and will carry 100 per cent. overload without any danger. Every part is within reach of the hand and every wire and connection in sight of the operator at all times, and the dimmer, even as large a one as that shown, can be moved around to any part of the stage by one man, The house electrician can repair any part of it, it not being necessary to send it back to the maker for repairs.

Vertical Automatic Engine Set.

The Ideal Electric & Manufacturing Company, of Mansfield, Ohio, is placing on the market a line of the enclosed type of vertical automatic engines, built especially for driving electric generators. Being of the vertical type, they are also particularly adapted to marine lighting sets and isolated plants where floor space is limited.

The engine is of the Racine pattern of the regular piston-valve type, with rings in valve and piston. All moving parts are adjustable. The crank shaft and connecting rod are of steel forgings and the governor is very sensitive, having a regulation within 2 per cent. from no load to full load.

These engines are built very strong, and are made durable and serviceable throughout. They are furnished with cast-iron shields



DIRECT-CONNECTED UNIT.

or covers on both sides of the frame which make them entirely enclosed and protect the generator from oil or water from the engine.

The generators are of the standard type of this company, the larger machines having six poles and the smaller ones four poles. The magnet frame is devised horizontally, the joint being covered by a rib which adds to the general appearance of the machine. The joints of the pedestal covers are concealed in the same manner. The field poles are of wrought iron, and fitted with a removable pole shoe of cast iron. The field coils are form-wound. The armature winding is of the barrel type, and also form-wound. The armature coil is built up of annealed sheet steel discs, the disc surfaces beiug oxidized before assembling on the spiders. The brush holders are of the parallel movement type, having a box provided with a screw and clamp to hold the brushes in position, the adjustment being obtained by means of a screw and tension spring.

Wood Turning Lathe.

We show in the accompanying cut a 10-in. "Star" wood-turning lathe of a new design which has just been placed on the market. This lathe is admirably suited for use in manual training schools as it contains many desirable features for such work and is commended to wood turners in general. The rated size of the lathe is 10 in., but it has an actual swing of 11 in. over ways and 7 in. over hand rest. The head stock is of the web pattern, strong and solid, has a hollow spindle (with 17/32-in. hole) made from a crucible steel forging and runs in large phosphor bronze bearings which are dust-proof and self-oiling and will run at a high speed for a very long time without attention. The spindle is ground true and the bearings are hand-

scraped to an accurate fit. The cone pulley has four steps, is turned inside as well as outside, and is in perfect balance for high speeds.

The tail stock is the curved or cut-under pattern, has a long bear-

WOOD TURNING LATHE.

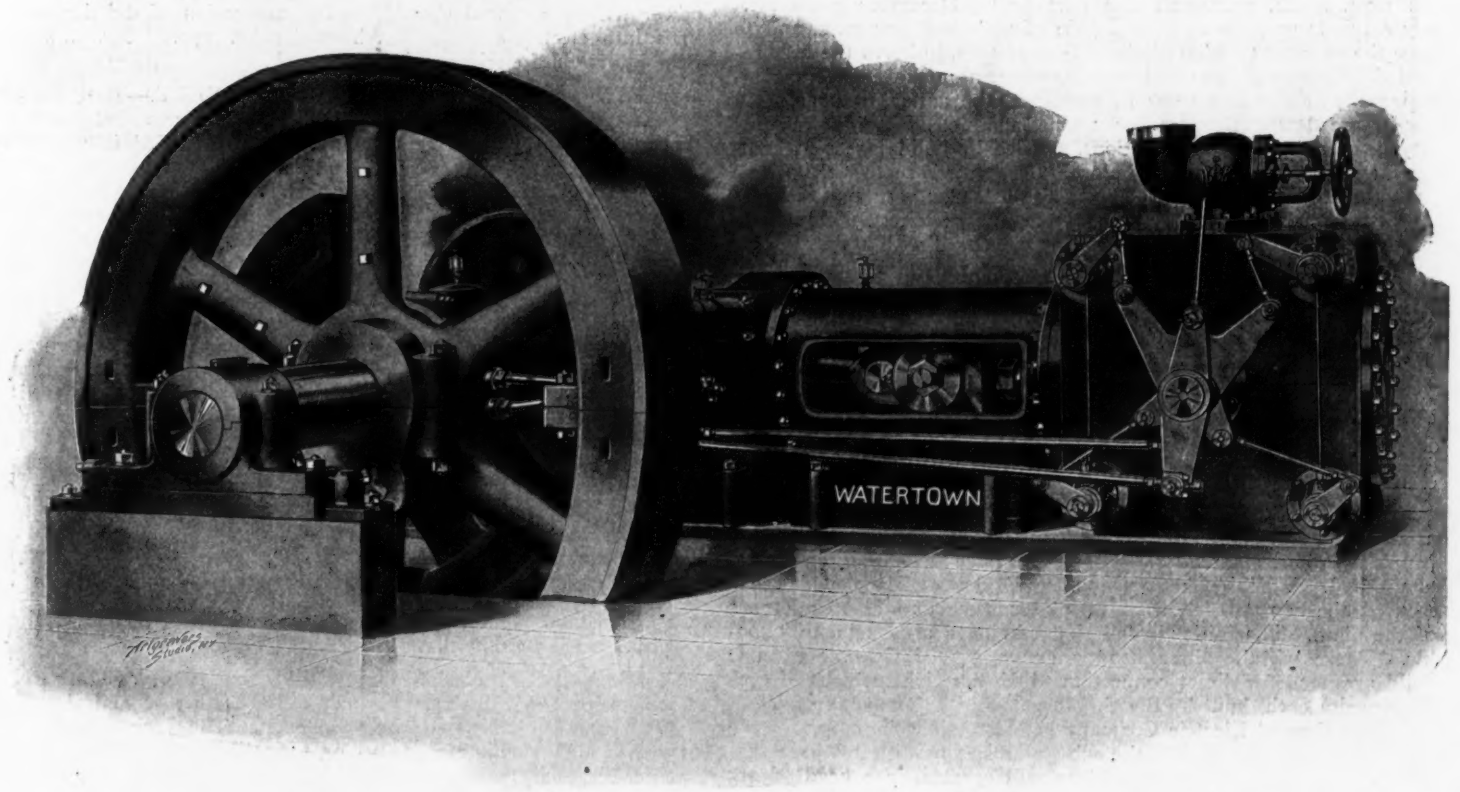
ing on the ways, and is firmly locked to the bed by a convenient lever, which is attached and always in place. No wrench is required. The tail stock spindle is locked by an improved locking device. The hand rest has long and short T-rests. The rest socket and saddle are locked to the bed by a cam-locking device, and the T-rest is held in the socket by a friction clamp, doing away with the set-screw com-

and spur centers are furnished with each lathe, and when desired a slide rest for metal turning is furnished. This lathe is manufactured by the Seneca Falls Manufacturing Company, 422 Water Street, Seneca Falls, N. Y.

New Watertown Engine.

The accompanying illustration shows the latest type of engine of the Watertown Engine Company, Watertown, N. Y., which is just being placed on the market. Among the improvements introduced in this engine are the location of the steam and exhaust valves on opposite sides of the cylinder, which of course means that the abrupt changes in temperature of the valve seats and cylinders due to alternate contact with admission and exhaust steam, are avoided. Moreover, the entering steam does not have its working efficiency impaired by cooling from the proximity of the exhaust, as in the case of a single-valve engine. The live steam ports are so arranged as to surround and jacket a large proportion of the cylinder walls, while the exhaust steam is kept from contact with the outside of the cylinder and is carried off as directly as possible. The steam and exhaust valves are controlled by an entirely separate mechanism, so that the exhaust remains constant under all variations of load. The above features are, of course, common to nearly all engines of the Corliss type, and it is to these points that the Corliss engine owes its unquestioned economy. This engine thus realizes Corliss economy in combination with the advantages of somewhat higher speed and a better regulation.

The valve gear mechanism being positive and without dash-pots, the speed of the engine is not limited as with the Corliss releasing gear, and can be adjusted or varied to meet the requirements of the work. The governor gives an absolute control of the speed of the engine within a very wide range of adjustment. Since the valve



A LATE-TYPE HORIZONTAL ENGINE.

monly used. Both are operated by levers attached and always in place, no wrenches being required.

The bed is broad and deep, and being thoroughly braced by cross webs is very stiff and rigid, and at present is made in two lengths, 4 and 5 ft. long. The front way is flat and the back way is V-shaped. A convenient shelf is secured to the back of the bed for the reception of tools, etc. The countershaft has self-oiling and self-aligning shaft bearings, four step cone and tight and loose pulleys, and the loose pulley has a self-closing oil cup. The face plate, screw chuck, cup

mechanism is positive and without complicated features, it is practically noiseless in operation. This design is especially suitable for engines of 300 to 3,000 hp operating direct-connected generators for railway, lighting or power service. Its higher speed allows the use of, smaller and therefore less expensive generators than with long-stroke Corliss engines, with a corresponding reduction in floor space occupied by the unit. The illustration clearly shows the extremely heavy construction, the compact design and the simplicity of mechanism of the engine.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The business conditions during the first week of the new year were favorable, and extensive preparations are being made for an active trade. The closing months of 1904, as shown by annual reports, made a much better exhibit than the first half, the new year starting with smaller stocks of goods in the hands of dealers assuring liberal contracts in the near future for replenishing supplies. A few minor labor controversies have arisen, but the Fall River mills are more active, and in most branches of manufacture there is a steady decrease in the proportion of idle machinery. Storms have again caused temporary delay to traffic, but the more ample water supply is a beneficent influence more than off-setting any injury in the aggregate. As inventories and repairs are completed, the various departments of the iron and steel industry steadily extend operations, and the sentiment is in striking contrast to the conservatism that prevailed a year ago. New business is gradually coming forward, the needs of consumers are being felt in all sections of the market, while production is no longer retarded by adverse weather. The strength of iron and steel prices, if anything, outruns demand, which, though quieter, still exceeds other years at this period in the volume of new business coming to hand. Consumers of pig iron are eager for supplies, and northern iron is 50 cents higher, while southern is firmer than of late. Some complaint of the railroads being slow to order rails comes to notice, but it is observed that some good-sized orders were booked last week, and a leading southern mill is filled up for 1905. A cloud on the industrial activity in New England is the stagnation in the bituminous coal trade growing out of the car shortage in that section. Congestion on the railways is not confined to this section entirely. The coal, coke, lumber, ore and grain trades note the presence of this as a disturbing element in the central west, south, southwest and northwest. December gross railway earnings promise to show a gain of at least 8 per cent., and to close the year 1904 with a slight gain over 1903, hitherto the best recorded. Current failure and clearings returns make excellent comparisons with the first week of 1904, and the annual returns, as a whole, are better than earlier seemed possible. Money remains easy, as heretofore, and collections, swelled by holiday results, compare favorably with the year before. *Bradstreet's* reports that there were 10,422 business failures during the calendar year 1904, involving $143,300,845 in liabilities and $75,927,364 of assets. This is an increase of 6.7 per cent. in number, as compared with 1903, and 4.5 per cent. over 1902. The liabilities decreased 7 per cent. from 1903, but increased 36 per cent over 1902. The percentage of assets to liabilities was 53.1, as against 54.5 in 1903 and 48 per cent. in 1902. The number of failures during the week ending January 5 was 268, against 218 the week previous and 262 the corresponding week last year. The copper production of the world for 1904 was, according to one authority, 632,166 tons, against 578,876 tons in 1903, and 542,167 tons in 1902. The market during the week was firmer, Lake being quoted at 15⅛ to 15¼c.; electrolytic, 15 to 15⅛c.; casting stock, 14¾ to 14⅞c.

EQUIPMENT FOR CHITTENDEN POWER PLANT.—The principal contracts for the equipment of the Chittenden Power Company's hydraulic plant near Rutland, Vt., have just been determined upon by J. G. White & Company, 49 Exchange Place, which has secured the complete contract for the construction and equipment of the plant. The initial installation will have a capacity of 1,200-kw. There will be three 400-kw generators of General Electric build arranged for direct connection to McCormick turbines of 770-hp capacity each, built by the S. Morgan Smith Company, of York, Pa. The General Electric Company has also taken the order for the equipment to be installed in the sub-stations, consisting of three 150-kw rotary converters. The turbines will operate on a head of 215 feet. Considerable construction work has already been completed on the Chittenden project. Large dams and reservoirs have been built, also a 5-ft. steel conduit 8,000 feet long, running from the dam to the site of the power house. The energy will be transmitted to Rutland for general uses. The transmission line will be about seven miles in length. It will operate at 13,000 volts. The Chittenden Company is controlled by the Merchants' Trust Company, of 420 Broadway. Mr. John Bogart, Post Building, is the consulting engineer, and French & Bryant, of Boston, Mass., are the local engineering experts.

EQUIPMENT FOR CANADIAN CAR PLANT.—Considerable electrical equipment will be utilized in the plant which the recently organized Canada Car Company, of Montreal, is to build at Saint Henri. The power plant will have a capacity of 1,500 hp. Several electric traveling cranes will be installed. Contracts have already been signed with the Canadian General Electric Company, of Peterborough, Ont., for two 500-kw, 1,600-r.p.m. Curtis turbines; one 25-kw turbo exciter set and one motor exciter outfit of 30-kw capacity. The contract for the boilers has been taken by the Babcock & Wilcox people. Mr. W. P. Coleman, formerly one of the vice-presidents of the American Car & Foundry Company, is president and general manager of the Canada Car Company. The directorate includes Mr. Fred Nicholls, general manager of the Canadian General Electric Company, and Mr. H. S. Holt, president of the Montreal Light, Heat & Power Company, two very strong personalities.

MEXICAN POWER TRANSMISSION PROJECT.—The Guaynopita Copper Company, organized under the laws of the State of West Virginia, with a capital stock of $5,000,000, a project of Col. W. C. Greene, of the Greene Consolidated Copper Mining Company, has acquired concessions from the Mexican authorities permitting of the utilization of some 30,000 hp from the Aros River, located in the State of Chihuahua. The construction of extensive power transmission lines is mooted, it being intended to operate the company's smelters and reduction works. The material, machinery, etc., to be used in the construction and equipment of the power plant and transmission lines will be exempted from import duty. The New York offices of the company are in the Blair Building, Broad Street.

5,000 HP PLANT FOR GUADALAJARA.—The Compania de Luz Electrica de Guadalajara, in which the late Mr. J. M. Bermejillo, the Russell Sage of Mexico, was the principal stockholder, has completed plans for the construction of a hydro-electric plant of about 5,000-hp capacity. The plant will be located near the Juanicitlan Falls. The company furnishes electric light and power in Guadalajara and owns the chief street railway lines in that city. Further power will be required shortly, as the conversion of existing mule lines into electric traction has been decided upon. Mr. Mariano Schiffino is chief engineer of the company.

EXETER COAL HANDLING MACHINERY.—The Exeter Machine Works, Havemeyer Building, have been awarded the contract for the coal handling machinery to be installed in the New York Central power houses at Yonkers and Port Morris, N. Y. The Nassau Light & Power Company has also placed a substantial contract with the Exeter people for a coal handling equipment, while the Exeter Le Grand gravity system is to be put in the Pennsylvania Railroad Company's Park shops power house, Philadelphia.

LINE MATERIAL FOR JAPAN.—The Albert & J. M. Anderson Company, of Boston, Mass., has secured a substantial contract for line material for shipment to Japan for use in the construction of the Yokohama Electric Railway Company's system. The contract was closed through the British electrical engineering and contracting firm of L. J. Healing & Company, of Yokohama, who are represented by Mr. Francis A. Cundill, 90-96 Wall Street.

DISABLING A TELEPHONE CABLE.—The Bell telephone management at Hamilton, O., received many complaints lately as to interrupted service. On investigation, some 50 telephones being put out of communication, it was found that some mischievous vandal had fired a load of buckshot into one of the big lead-covered cables. The shot had gone clean through the cable in places, showing short-range fire, and many of the wires were severed or short circuited. Such an act is a penitentiary offence in Ohio.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, has recently shipped an additional section of central energy switchboard equipment to Jackson, Tenn. The Jackson exchange now has an immediate capacity for 1,260 lines, which represents a 50 per cent. increase over the original installation. Several increases have been made since the board was installed.

JALISCO POWER PROJECT.—It is proposed to build a good-sized hydraulic plant on the Ayutla River, State of Jalisco, Mexico, for the purpose of generating electric energy for transmission to the Casa Blanca mines, municipality of the Union de Tula. Mr. Francisco Laveaga, of Guadalajara, represents the principal interest in the project. The necessary concession is now being sought from the State authorities.

TELEPHONE BUILDING FOR CHICAGO.—The Chicago Telephone Company has let contracts for the construction of a telephone exchange for the Northwestern district. The building which will be located at 794-796 Northwestern Avenue, will cost $25,000.

CUBAN WATER POWER PROJECT.—A change has been made in the plans of the Cienfuegos Palmira & Cruces Railroad & Electric Power Company. The company, which is controlled by Cuban and German capitalists, Mr. Bruno Diaz, a wealthy Cuban tobacco merchant, being president, while Mr. Cornelius C. Vermeule, 203 Broadway, acts as consulting engineer for the undertaking, proposes to construct a hydro-electric plant at the Falls of Hababinalla, the Niagara of Cuba, which will have an initial capacity of 3,000 kw, and an ultimate development of about 7,000 kw. The plant will be located about 30 miles from Cienfuegos, one of the most flourishing seaport towns on the Island. Cieufuegos and its suburbs will be furnished with current for lighting purposes from the Hababinalla plant. The local lighting interests will be taken over by the company. Three thousand five hundred incandescent lamps is the extent of the present system. The new owners will instal some 5,000 more, and will also put in about 250 arc lamps for the purpose of lighting the streets. The plant at Santa Clara, controlled by the Abren family, will also be taken over by the Cienfuegos, Palmira & Cruces Railroad & Electric Power Company, and the lighting system in that city will be considerably enlarged. Lighting installations will also be put down in the towns of Cruces, Palmira and Caonao. In these three places about 150 arcs in all will be used in the first instance. The pipe line will be formed of three 36-in. telescopic lap-jointed, steel riveted pipe, each about 2,657 ft. long. Upwards of 1,000 tons of cement will be utilized in the construction of dams on the Hababinalla and Negro rivers. The initial power house equipment will include three water turbines direct connected to generators of 1,000 kw. each. The main turbines will be of impulse type designed for a head of 470 feet. The generators are to be of three-phase, 25 cycle, 300 r.p.m., 2,100 to 2,300 volt type. Two exciters, 6-pole, 75-kw., 500 r.p.m., 110 to 125 volts machines, each direct coupled to a 3-ft. water-wheel, will also be put in. Four three-phase compound wound, 25 cycle, 300-kw., 600-volt, 500 r.p.m., 6-pole rotary converters, also two three-phase motor generator sets of stationary armature type for changing frequency for 25 to 50 or 60 cycles, each consisting of a three-phase generator of 300 k.v.a. capacity, directly coupled to a synchronous motor for 25 cycles, and for same voltage as three-phase side of rotary converters. Nine single-phase, 25-cycle, 350-k.v.a. step-up transformers for the main power house and step-down transformers for substation equipment from three-phase, 25 cycle for 300-kw., 600-volt direct-current three-phase converters will also be contracted for. The primary voltage will be 21,000 volts. Substations will be built at Cumanayagua, Guaos, Caonao, Palmira, Cruces and Santa Clara. The power transmission system will, in the first instance, be about 40 miles in length. Mr. Vermeule said to a representative of the ELECTRICAL WORLD AND ENGINEER that the company was waiting the passage of the bill by the Cuban Congress relating to the reduction of import duties before any of the contracts were awarded. He confidently expected, however, that the bill would go through inside of two months.

EQUIPMENT FOR MINING POWER PLANT.—The Palmer Mountain Gold Mining & Tunnel Company, a $5,000,000 concern, 56 Wall Street, and of which Mr. John Boyd is president and general manager, has awarded a contract to the Allis-Chalmers Company, of 71 Broadway, for equipment to be installed in its water power plant on Palmer Mountain, Loomis, Okanogan County, Washington. The company has acquired the Toats Coulee Creek from which the necessary power will be derived for operating the reduction works and compressor plants, also lighting the mine and the mine buildings. The surplus power will be utilized in adjoining mining properties. The power house is now under construction at a point located about 1¾ miles from the mine. The creek is capable of generating 3,000 hp, but in the first instance a 750-hp equipment only will be installed. The machinery just contracted for will consist of a 450-kw. Bullock generator direct connected to 750-hp turbine of Escher-Wyss design, for which the Allis-Chalmers people have the exclusive American rights. The turbine will operate on a 325-ft. head.

STURGESS GOVERNORS AT MISHAWAKA.—The water power plant equipped recently at Mishawaka for the St. Joseph (Ind.) & Elkhart Power Company, described in our pages, has an outfit of Sturgess governors made by the Sturgess Governor Engineering Company, of Watervliet, N. Y. The equipment consists of three No. 2 size, type A governors capable of developing an energy of 20,000 foot-pounds, and three No. 2 size pumps, all delivering oil into one pressure tank. This tank is mounted on the wall in a horizontal position and is divided into two compartments, one pressure and the other vacuum, from which are piped connections leading to the three power unit governors and the exciter unit governor, which is a No. 0 size E type governor capable of developing 6,000 foot-pounds. These governors are all equipped with motor control for easy operation for synchronizing and have proved very successful in their operation. This central pressure system is a modern development of governor installation, and requires very careful consideration in dealing with all the problems that its adoption develops.

HAMILTON-HOLZWARTH TURBINE ORDERS.—The Hooven, Owens & Rentschler Co., of Hamilton, O., reports through its New York manager, Mr. W. B. Mayo, 39-41 Cortlandt Street, receipt of contracts for Hamilton-Holzwarth steam turbines of 1,000 kw, and 500 kw capacity, respectively. A 150-kw, 2,400 r.p.m. turbine, to be direct connected to two 75-kw, three-wire system Crocker-Wheeler generators, is to be installed in the lighting plant at the University of Minnesota, Minneapolis, and a 150-kw, 3,600 r.p.m. machine, has just been ordered by the Mittineague (Mass.) Paper Company for power purposes. This turbine will be direct connected to a 240-volt Crocker-Wheeler alternating-current generator. Delivery will be made in the spring.

BUFFALO FANS FOR JAPAN.—The Buffalo Forge Company, 39-41 Cortlandt Street, has secured a contract for fifty 18-inch ventilating fans for export to the Mikado's empire, where they will be installed in arsenals and railroad shops. The fans will be driven by Westinghouse alternating-current motors. The Buffalo company has also taken an order from the United Dressed Beef Company, New York, for a 10-ft. fan to be operated by a 35-kw motor of Crocker-Wheeler build. Two 9-in. by 10-in. horizontal centre crank Buffalo engines have been ordered for direct connection to Sprague motors for the lighting equipment in the Hotel Earle, 103 Waverley Place.

CENTRAL SOUTH AFRICAN ROAD.—South African advices state that the electrification of the Springs and Randfontein section of the Central South African Railway is projected. The length of the section is 57 miles. The power station will be located at Germiston, and will be so planned that additional equipment may be installed to take care of the conversion, also proposed, of the Pretoria branch of the same system. Three-phase will be used. Mordey & Dawbarn, the London electrical engineers, are being consulted in the matter.

RAIL JOINT FACTORY.—The Joliet (Ill.) *Republican* announces that the Illinois Steel Company there is about to begin an extension of its works at a cost of $100,000 to accommodate the business of the Continuous Rail Joint Company of America. The latter company is a New Jersey corporation, with headquarters at Newark, N. J. It has extensive works at Troy, N. Y., but has found its western business requires a plant nearer the centre of trade, and for that reason has entered into the arrangements noted above with the Joliet company.

PASSAIC, N. J., POWER PLANT PROJECTED.—The construction of a power plant at Passaic, N. J., is contemplated by the Weehawken Construction Company, of which Mr. H. L. Mannahan, of Fourth Street, Weehawken, N. J., is president. There will be two 400-kw alternating-current generators arranged for direct connection of cross-compound condensing engines of 600 hp capacity each. There will also be about 200 hp of motors of various sizes.

LIGHTING EQUIPMENT FOR FLAXMILLS.—The Barbour Flax Spinning Company, of Paterson, N. J. is to instal further electrical equipment for general power and lighting purposes. Mackenzie, Quarrier & Ferguson, 114 Liberty Street, have secured a contract for a Harrisburg-Fleming side crank engine direct connected to a Crocker-Wheeler generator.

MOTORS FOR NATIONAL WIRE PLANT.—The National Wire Corporation is to instal further electrical equipment in its New Haven, Conn., plant, and has already placed a contract with the Crocker-Wheeler Company, for several motors, including one of 110 hp capacity; one of 75 hp and three of 35 hp each. These motors will be 230-volt machines.

TELEPHONE CONTRACT FOR BELLAIRE, O.—The contract for the installation of the new telephone system in Bellaire has been let to the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The contract provides that the system be installed by April 1. The plant will have a capacity for 2,200 telephones, but only 800 will be installed at first.

EQUIPMENT FOR LOFT BUILDING.—A good-sized lot of equipment will be put in a new loft building to be built at 33-39 East Twenty-first Street by Mr. Jeremiah W. McDonald, of 37 East Twenty-first Street, and Mr. George D. Wick, of 150 Fifth Avenue. D. H. Burnham & Co. are the architects.

PLANT FOR LANGHAM APARTMENT.—The Langham Realty Company, G. M. Mathers, 21 Park Row, is president, is to put down a lighting plant in its big apartment hotel to be built at 57-59 West Forty-sixth Street. Buchman & Fox, of 11 East Fifty-ninth Street, are the architects.

MOTORS FOR WAIST FACTORY.—The Economist Waist Company, of 192 Green Street, will shortly occupy premises at 72 Fifth Avenue, where several small motors, it is expected, will be installed.

PLANT FOR WYOMING APARTMENT.—Figures will be taken within the next fortnight on the lighting equipment to be put in the new apartment hotel to be built uptown by the Wyoming Apartment Company, of which Mr. Clifford E. Potter, 137 Broadway, is president.

EQUIPMENT FOR DAVIES & THOMAS.—Davies & Thomas, of Catasaqua, La., have placed a contract for a 300-kw Crocker-Wheeler generator to be direct connected to a Erie City engine. The outfit will be used for power.

EQUIPMENT FOR SILK MILLS.—The Champlain Silk Mills Company, of Whitehall, N. Y., is about to let orders for two 100-kw generators direct connected to 150-hp engines, and several motors will also be bought.

LOWEST BIDDER FOR SCHOOL.—The O. K. Electric Construction Company, of 725 Broadway, is the lowest bidder for the electrical equipment to go in Public School No. 15. The figures were $8,200.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation on the New York Stock Exchange was quiet, although there was a strong undertone and irregularity in prices. A disposition is shown to await the possibility of Congressional action upon railroad rate regulation or the subjection of industrial corporations to interstate commerce supervision. Amalgamated Copper exhibited manipulative strength, attended by rumors of increased dividends. Bonds are very strong, with a steady investment demand, in keeping with the ease and abundance of money. The United States Steel shares seemed to be influenced by realizing sales, although these issues were at no time features in the general market. Electric and traction stocks were all quiet and weak, business being limited: Allis-Chalmers, common and preferred, closed at the lowest prices of the week, 16 and 65¾, respectively, being net losses of 1¼ and 3¾ points. General Electric touched 187¾, fell off to 186, but rallied and closed at 187. Westinghouse lost 1 point net on the week's business, closing at 179, which was also the lowest price of the week. Western Union closed at 93¼. Of the tractions, Brooklyn Rapid Transit closed at 59¾, a net decline of 1½ points, and Metropolitan Street Railway 115½, a net loss of 5 points. On the curb market Interborough Rapid Transit made a new high-price record, closing at 170¼, which is a net gain of 6¼ points. Following are the closing quotations of January 10:

NEW YORK

	Jan. 3	Jan. 10		Jan. 3	Jan. 10
Allis-Chalmers Co.	16	16	Electric Vehicle	..	11
Allis-Chalmers Co. pfd.	66	64	Electric Vehicle pfd	..	20
American Tel. & Cable	93⅛	93⅛	General Electric	187	186¾
American Tel. & Tel.	146	146⅜	Hudson River Tel.	..	..
American Dist. Tel.	..	38	Interborough Rap. Tran.	..	180¼
Brooklyn Rapid Transit	61¾	60¼	Metropolitan St. Ry.	120⅛	115⅝
Commercial Cable	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	..	40	Marconi Tel.	..	..
Electric Boat pfd.	..	80	Western Union Tel.	94¼	92⅛
Electric Lead Reduction	..	⅛	Westinghouse com	179	179
			Westinghouse pfd	190	187

BOSTON

	Jan. 3	Jan. 10		Jan. 3	Jan. 10
American Tel. & Tel.	147⅛	146	Western Tel. & Tel. pfd.	*100	*89½
Cumberland Telephone	121⅛	121	Mexican Telephone	1¾	1¾
Edison Elec. Illum.	*254	251	New England Telephone	138	138½
General Electric	188	185	Mass. Elec. Ry.	13⅜	13½
Western Tel. & Tel.	*20	*19½	Mass. Elec. Ry. pfd.	59	58½

PHILADELPHIA

	Jan. 3	Jan. 10		Jan. 3	Jan. 10
American Railways	48	47½	Phila. Traction	98⅝	99⅛
Elec. Storage Battery	78	76	Phila. Electric	10¼	9¾
Elec. Storage Battery pfd.	78	75	Phila. Rapid Trans.	17⅜	17⅜
Elec. Co. of America	11⅛	11⅛			

CHICAGO

	Jan. 3	Jan. 10		Jan. 3	Jan. 10
Central Union Tel.	..	..	National Carbon pfd.	110	110
Chicago Edison	170	..	Metropolitan Elev. com.	22⅛	22
Chicago City Ry.	189¾	192	Union Traction	9¼	11⅞
Chicago Tel. Co.	..	143	Union Traction pfd.	..	45
National Carbon	41	41½			

* Asked.

PUBLIC SERVICE CERTIFICATES.—The Fidelity Trust Company and Eisele & King, bankers, of Newark, N. J., join in an offering of $2,000,000 of the perpetual interest-bearing certificates of the Public Service Corporation of New Jersey. The certificates are advertised as a portion of a total issue of $20,200,000, of which $19,018,370 are outstanding. The certificates are offered at 110 and interest, netting about 5½ per cent. on the investment. By the terms of these certificates the Public Service Corporation agrees to pay interest on a graduated scale, beginning at 2½ per cent. in 1905, and increasing at the rate of ½ per cent. per annum until May, 1912, when and thereafter a rate of 6 per cent. per annum, payable semi-annually, will be paid and maintained. The Fidelity Trust Company indorses its agreement to pay each year up to 1912 an additional amount of interest, thus in proportionate amounts establishing a rate of 6 per cent. per annum forthwith. The Public Service Corporation issued the certificates now offered in payment for shares of the North Jersey Street Railway, the Jersey City, Hoboken and Paterson Street Railway, Orange and Passaic Valley Street Railway and the United Electric Company of New Jersey. The voting power of the United Service Company on these shares cannot be exercised to increase the capital stock of subordinate properties or create any further or prior lien inconsistent with the integrity of the present certificate issue.

CONNECTICUT TROLLEY OWNERSHIP.—An official statement has been made by the New York, New Haven & Hartford Company in regard to its alleged purchase of the trolley lines between Stamford, Conn., and New Rochelle, N. Y., from Colonel Heft. Several inquiries were made of the railroad officials asking if the line mentioned above had been taken over by the Consolidated Railway Company for $1,500,000. The official statement follows: "The Consolidated Railway Company is negotiating for and will probably complete the purchase of the majority of, or controlling interest in the stock of the trolley systems from Stamford to Greenwich and New Rochelle; but the negotiations are not upon any such basis as the figures stated above. The trolley companies which control the lines between Stamford and New Rochelle are the Greenwich Tramway Company and the New York & Stamford Street Railway Company."

CHICAGO UNION TRACTION.—By the largest vote ever recorded at an annual meeting of the North and West Chicago Street Railway Companies, the corporations immediately underlying the Union Traction Company, a compromise list of directors has been elected. The Blair-Rawson element secured three of the five directors in the North Chicago board and four of the seven West Chicago directors. The others were named by Mr. Govin, and all were approved by Judge Grosscup, who was the first to attempt to bring the warring factions together. The new board of the North Chicago Company is composed of Frederick H. Rawson, Henry A. Blair, Charles L. Raymond, Lafayette McWilliams and E. D. Hulbert. The West Chicago board is composed of Frederick H. Rawson, Henry A. Blair, Wallace Heckman, William Neisingrath, Lafayette McWilliams, E. D. Hulbert and George E. Adams.

GENERAL ELECTRIC BUSINESS.—According to advices from Boston, the General Electric Company's sales for the year will amount to $36,700,000, or about $5,000,000 less than last year. The sales for the past six years have been:

1898	$15,679,000
1899	22,379,000
1900	28,783,000
1901	32,338,000
1902	36,685,000
1903	41,699,000

Early in the year it was thought the loss would be much larger, but the general improvement in business in the East has been reflected in the electric industry during the past few months.

TROLLEY RECEIVERSHIP IN OHIO.—In the United States Circuit Court at Cleveland, Judge Thompson has appointed receivers for three Ohio traction companies as follows: The Central Market Street Railway of Columbus; the Dayton, Springfield & Urbana Electric Railway Company, and the Columbus, London & Springfield Railway Company. Jacob H. Schmidlapp, president of the Cincinnati Union Trust Company, and Myron H. Wilson, treasurer of the Cleveland Trust Company, were appointed receivers. The preliminary to applications for receivers was the filing of a suit against each of the roads and the entry of immediate judgment with the consent of the representatives of the roads. The three roads are a part of the Appleyard system.

INDEPENDENT TELEPHONE EARNINGS.—The statement of earnings of the United States Telephone Company, of Cleveland, O., for November shows an increase of 18 per cent. in gross. The results of the expenditures of the year and the revival in business are beginning to show in the earnings of this company. There is a fair increase shown in net and surplus earnings. The statement compares as follows:

	Nov., 1904.	Nov., 1903.
Gross earnings	$37,504.10	$31,836.61
Expenses and taxes	25,659.66	21,317.90
Net earnings	11,844.44	10,518.71
Deductions	8,341.49	8,105.26
Surplus	3,502.95	2,413.45

TROLLEY IN THE YELLOWSTONE.—It is reported that a strong company, the Yellowstone Valley Rapid Transit Company, has in hand the building of an electric line through the entire length of the lower Yellowstone Valley running from Glendive Mont to a point on the Missouri River opposite Buford, N. D. It will connect the Great Northern and Northern Pacific roads, and makes possible entirely new itineraries for tourists covering the Northwest and the Yellowstone Park region.

DIVIDENDS.—The Electric Company of America directors have declared a semi-annual dividend of 35 cents per share, a rate of 7 per cent. per annum. This is an increase, the rate since 1902 having been 6 per cent. per annum. The question of a 10 per cent. stock allotment was considered and left in the hands of the executive committee.

General News of the Week

The Telephone.

PHOENIX, ARIZ.—Work will be started at once on the government telegraph line between Phoenix and the Arizona dam, the present western terminus of the Roosevelt line.

PASADENA, CAL.—The Home Telephone Company will expend between $10,000 and $20,000 in the improvement of lines between Pasadena and Los Angeles. The work has been commenced under the supervision of the United States Company.

SAN DIEGO, CAL.—The Home Telephone Company, of this city, has recently built a three-story brick building on Sixth Street. The lower flat is fitted up with the offices of the company, the remainder of the building being used for the general equipment which essentially consists of a switchboard for 1200 lines, which it is expected will be enlarged to accommodate 3000 in the course of the year 1905; duplicate power set of 150-amp. hour storage batteries, principally charged by Holtzer-Cabot motor generator, and as a reserve a 1-kw generator operated by a Fairbanks Morse 1-hp gas engine. The ringing is operated by a 500-volt ¼-hp motor direct-connected to an 80-volt, 20-cycle generator, manufactured by the Holtzer-Cabot Company, for the day, and the night rings by a 1-6-hp dynamo operated from a storage battery. The telephone manufactured by the Automatic Electric Company, of Chicago, and fitted with the customary busy and howler attachments, is used exclusively in this exchange. The building and equipment represents a total cost of $250,000.

HOPEDALE, ILL.—The capital stock of the Farmers' Telephone Company has been increased from $5000 to $20,000.

FISHER, ILL.—The Grangers' Mutual Telephone Company has increased its capital stock from $15,000 to $20,000.

LENA, ILL.—The Howardsville Telephone Company has been organized. The incorporators are Edward Fisher, George W. Davis and F. A. Howard.

GRAYVILLE, ILL.—The Westfall Telephone Company has been formed, capital $4000. Incorporators: W. F. Westfall, Claude O. Ellis and Nathan March.

PETERSBURG, ILL.—The Petersburg Telephone Company has been capitalized at $20,000. The incorporators are J. S. Hurie, R. A. Kelly and Richard Waldridge.

CHICAGO, ILL.—During December the Chicago Telephone Company gained 1520 new subscribers. The total increase for the year was 16,547 telephones, giving a total of 117,734 in service.

ST. JOSEPH, ILL.—The following officers have been elected by the recently incorporated St. Joseph Telephone Company: President, O. C. Boggs; vice-president, T. J. Wardin; treasurer, N. G. Glascarch; manager, J. O. Henderson.

CHAMPAIGN, ILL.—The Somer Township Mutual Telephone Company has been organized by 76 stockholders who believe they should own their medium of exchange. Telephones are rented at $1 a month and any farmer who wishes to connect himself with the company can do so by paying $70, which gives him free service.

CHICAGO, ILL.—Mr. J. K. Johnson, manager of the Home Telephone Company of Elkhart, Ind., proposes to build a long-distance telephone line into this city if his proposals meet the sanction of the president of the Illinois Tunnel Company. Mr. Johnson is said to voice the intentions of the independent telephone companies of Michigan, Ohio, Indiana and Illinois, whose merger is in progress.

INDIANAPOLIS, IND.—The farmers of Indiana are demanding legislation which will prohibit the destruction of roadside trees by telephone linemen.

GREENFIELD, IND.—The Beech Grove Telephone Company has filed articles of incorporation. The capital stock is $500. George W. Cinders, George Offenback and Chas. H. Stoner, of Oaklandon, are the incorporators.

AURORA, IND.—The Farmers' Co-operative Telephone Association, of Dearborn County, has incorporated with a capital stock of $1000. Nelson Grinsley, H. N. Christy, D. E. Clement and others are incorporators.

LIBERTY, IND.—The Liberty Telephone Company, of Liberty, which was recently reorganized, has filed articles of incorporation with the Secretary of State at Indianapolis. The new company has a capital stock of $20,000.

CRAWFORDSVILLE, IND.—A. F. Ramsey, president of the Home Telephone Company, has leased the lines of the Co-operative Company, which has a franchise and was regularly organized as a stock company doing business in this city. The deal has been completed and a trunk line runs from the main home office to the Pike Street station, where the switchboard is kept. The entire co-operative system will be revamped by the Home Company and the subscribers acquired in the deal be given direct connection with the home office. The co-operative switchboard will be taken out.

LEBANON, IND.—This city has just passed through a telephone struggle. Recently the City Council granted a franchise to the Central Union Telephone Company, giving it what looked like a more liberal bill of rights than that enjoyed by the Lebanon Telephone Company. Last meeting night the Council granted the Lebanon Company a similar franchise. The new one contains no restriction as to rates and is for twenty years. The old franchise which would not have expired for four years, was cancelled. The Council treated both companies alike. The citizens generally oppose a dual system.

TULSA, I. T.—The Pioneer Telephone & Telegraph Company has announced that it will install a new telephone system in Tulsa with switchboard capacity of 2200 telephones. It will cost, when completed, in the neighborhood of $50,000. Nine new toll lines will be built in the Indian Territory by the company in the next six months.

SOUTH McALESTER, I. T.—It is announced that Wm. Busby, the heaviest coal operator in the McAlester district, has acquired a large interest in the South McAlester-Eufaula Telephone Company, owning exchanges at South McAlester, Eufaula, Hartshorne and Tishomingo and numerous toll lines and that as president he will name a superintendent and have charge of $50,000 worth of improvements.

GOWRIE, IA.—J. F. Nordim is seeking a franchise for a telephone line.

SIBLEY, IA.—An independent telephone system is projected by local business men.

ESTHERVILLE, IA.—The Emmet County Telephone Company will make improvements in its exchange.

BOONE, IA.—The Dodge-Harrison Telephone Company held its annual meeting when Fred Hein was elected president, Morris Garvey, secretary, and Adam Moeler, treasurer, for the ensuing year.

BOONE, IA.—The Farmers' Co-operative Telephone Company has elected the following officers for 1905: President, S. N. Gift; vice-president, M. G. Jacobson; secretary, R. W. Engstrom; treasurer, Arthur Wills.

EAGLE CENTER, IA.—The Hudson Mutual Telephone Company is said to have leased the U. S. Telephone Company's line from here to Hudson. As the Wettstein Company of La Porte City and the Voorhies Farmers' Telephone Company have their lines here, it is stated that now these three companies will establish a switchboard here and connect their lines.

PORTLAND, ME.—At the annual meeting of the stockholders of the Eastern Telegraph Company, held in this city recently, the following officers for the ensuing year were elected: President, Frederick Robie; treasurer, C. F. Ames; clerk, C. D. Livermore.

SAN LUIS POTOSI, MEX.—The work of constructing a telephone line between San Luis Potosi and San Felipe has been completed.

SALTILLO, MEX.—The Mexican Government has declared forfeited the concession which was held by J. Woessner, of Saltillo, for the construction and operation of a system of long-distance telephone lines in Northern Mexico. It is stated that Mr. Woessner was unable to comply with the terms of the concession. A part of the system was constructed and is in operation.

CITY OF MEXICO, MEX.—T. F. Maguire, general manager of the Mexican Telephone Company, says that the work of placing the telephone cables in the City of Mexico underground will be commenced some time this month. It is stated that the plan of the proposed underground system calls for an ultimate accommodation of 10,000 subscribers. A new switchboard will be installed in the company's headquarters on Calle del Arco del San Augustin, where its entire central plant was recently placed.

BOYNE CITY, MICH.—The Michigan State Telephone Company has purchased the Independent Telephone Company of Boyne City. The subscribers number 250 and the company has extensive mileage to the various logging camps in the vicinity of Boyne City.

SACRED HEART, MINN.—Carl Anderson contemplates installing a local telephone exchange.

BELGRADE, MINN.—The Commercial Telephone Company has been incorporated with $50,000 capital.

KERKHOVEN, MINN.—A stock company is projected to buy the local telephone exchange or install a new one.

NEW ULM, MINN.—The Blue Earth Telephone Company has been granted a franchise to enter this city.

KNAPP, MINN.—The Knapp Telephone Company will extend its lines through to Kingston in the near future.

BELGRADE, MINN.—The Commercial Telephone Company has been incorporated with a capital stock of $50,000.

ST. PAUL, MINN.—The Shakopee Telephone Company has amended its articles of incorporation, making the capital stock $50,000.

MANKATO, MINN.—At a meeting of the members of the Lyra Telephone Company officers were elected and the constitution and by-laws adopted. Material is all here and the line will soon be completed.

ST. PAUL, MINN.—The Cambridge Telephone Company, of Isanti County, has been incorporated with a capital stock of $50,000. The incorporators are Godfrey G. Goodwin, A. C. Bowe, G. K. Carlson and R. B. Hixon.

ST. PAUL, MINN.—The Nicollet County Telephone & Telegraph Company has filed two amendments to its articles of incorporation, one increasing its limit of indebtedness from $2000 to $5000, and the other increasing the capital stock from $50,000 to $100,000.

ST. PAUL, MINN.—The State treasury has received $11,584.50 from the Twin City Telephone Company. The amount was paid as the 3 per cent. gross earnings tax on the company's earnings in Minnesota. The gross earnings of the Twin City Company, as reported by its officers for the year ending Nov. 30, were $386,150.

HANNIBAL, MO.—The Missouri & Kansas Telephone Company has been granted a franchise by the City Council.

RICH HILL, MO.—The City Council held a special session January 4, to receive a proposition from J. S. J. McComb, of Humansville, Mo., who proposes to put in a local telephone system, cable the wires, give the city 2 per cent. of the gross receipts and free municipal telephones providing a twenty-year franchise is granted.

ST. LOUIS. MO.—The new telephone system of the St. Louis County Telephone Company, an independent organization, has been opened. The new company furnishes a telephone in a residence for $1.50 a month and in a business house for $2 a month, while the system was built primarily to afford local communication, arrangements have been made whereby St. Louis connection can be secured by the payment of toll rates to the other lines. The telephones work automatically.

ST. LOUIS, MO.—The Board of Public improvements has practically decided to authorize President Hiram Phillips to draw up an amendment to the Keyes conduit ordinance permitting the Bell Telephone Company to rent space in its underground conduits to the Western Union Telegraph Company. If this amendment is drafted into the ordinance regulating conduits, the Western Union may possibly drop the injunction proceedings against the city now pending in the Federal courts. According to President Phillips, the Bell Telephone Company is willing to pay into the city treasury 5 per cent. of the gross rental it receives from the Western Union for use of the conduits. The Postal Telegraph Company will build its own conduit, having asked for a permit from the Board of Public Improvements for the purpose.

DILLON, MONT.—The Rocky Mountain Bell Telephone Company is making repairs and improvements in its local system, involving an expenditure of $10,000.

MISSOULA, MONT.—It is stated by Superintendent Miller, of the Rocky Mountain Bell Telephone Company, that work is to commence immediately on the construction of a rural system to extend all through the Bitter Root Valley.

HELENA, MONT.—The Amador Railway Company has filed articles of incorporation with the Secretary of State, the capitalization being $1,000,000. The company is authorized, among other things, to operate a telephone and telegraph system.

JANSEN, NEB.—The Jansen Telephone Company has been organized by residents of Jefferson County with a capital of $10,000.

TRENTON, N. J.—The Bergen County Telephone Company, of Jersey City, has been incorporated with a capital stock of $5000. The incorporators are John T. Trumbull, Edward H. Hoos and Spencer Weart.

ROCHESTER, N. Y.—The Churchville Telephone Company has filed articles of incorporation with the County Clerk. The capitalization of the company is $5000, and it is to build and maintain an electric telegraph or telephone line in the town of Riga, connecting with other lines to different parts of the State. Its principal place of business will be in Churchville.

BUFFALO, N. Y.—The Bell Telephone Company has just placed on the market 5500 shares of new stock of the par value of $550,000. The new stock sells at par and may be subscribed for by present stockholders at the rate of one-tenth of a share of new stock for each share of old stock. Subscriptions will be received up to three o'clock on the afternoon of January 14.

UTICA, N. Y.—It is announced that the Independent Telephone Securities Company has secured a controlling interest in the lines of the Black River Telephone Company. The latter company's lines extend over a large part of Oneida, Lewis, Jefferson and Oswego Counties, and will now be connected with the system of the Utica Home Telephone Company. It has exchanges in 22 villages and over 1000 telephone subscribers.

WOLCOTT, N. Y.—There is now every indication, it is stated, that free telephone service in this place will soon be at an end. For more than a year the Empire State Telephone Company has been running a local exchange of nearly 100 subscribers free of charge, and has up to this time refused to establish a rate. Now the representatives of the company are soliciting contracts to begin Jan. 1 at a rate of $12 per year for residences and $24 for business places.

SYRACUSE, N. Y.—It has been decided to expend $2,000,000 in making improvements to the Central New York Telephone & Telegraph Company's system in central New York. A considerable portion of the money will be spent in Syracuse in the laying of additional conduits and stringing of more overhead cables. The company is also erecting a large new building on Montgomery Street and will install one of the finest switchboards in the country. Most of the appropriation will be used in improving and extending the service in the villages of central New York and neighboring cities.

MANIEN, N. D.—The Northwestern Telephone Company will extend its lines to Center next summer.

LAKOTA, N. D.—A rural telephone line to Harrisburg is projected, thence to Bue. W. A. Blake is interested.

JAMESTOWN, N. D.—The telephone exchange is to be improved and extended and considerable cable work installed.

GRAND FORKS, N. D.—A project has been started by C. A. Walker owner of the Brainerd telephone system, to build a line from Brainerd to Walker, taking in Jennings, Pequot, Pine River, Mildred and Hackensack. It will have connections here and at Brainerd with the Northwestern telephone system, giving service to the twin cities and Duluth.

CEDARVILLE, OHIO.—The Cedarville Telephone Company has increased its capital stock from $15,000 to $40,000.

OSSIAN, OHIO.—The Uniondale Rural Telephone Company has increased its capital stock from $1300 to $13,000. V. M. Hatfield is president.

BELLAIRE, OHIO.—The contract for the new plant of the Ohio Valley Telephone Company has been let to the Mountain State Electric Company, of Wheeling.

LEBANON, OHIO.—The stockholders of the Valley Telephone Company have elected the following members to serve on the board of directors: O. M. Bake, George G. King, H. S. Conover, Gibson Lowe and James Stoops. This company represents an outlay of $107,000, and during 1904 has cleared $10,000.

MARYSVILLE, OHIO.—N. E. Ligget, the principal owner of the Marysville telephone exchange and also owner of the toll line between Richwood and Marysville, has commenced work with a force of men on the erection of two circuits between Marysville and Richwood. The Richwood Telephone Company will connect with the Liggett lines at Pharisburg and better service is promised on or before March 1, 1905. The two new circuits will be for the long distance business and the present lines will be used exclusively for the rural lines.

WILLOW, OKLA.—A number of farmers of this vicinity have organized a mutual telephone company.

OKLAHOMA CITY, OKLA.—There is some talk of the Bell and Pioneer telephone companies being merged.

GUTHRIE, OKLA.—The Choctaw Telephone Company, of Durant, I. T., has sold its property, including toll lines to Dennison and Paris, Tex., and Hugo, I. T., to the Pioneer Telephone Company, of Guthrie, for $30,000. This sale practically puts the Pioneer Company in complete control in Oklahoma and Indian Territory.

PORTLAND, ORE.—Charles Sunner, said to represent the Empire Construction Company, of Los Angeles, has asked the Council for a franchise for an automatic telephone system and offered the city a bonus of $37,000.

INDEPENDENCE, ORE.—The Independent Telephone Company will be incorporated in the near future with a capital stock of $10,000. J. R. Craven is chairman of the board of directors. The matter of installing a switchboard will be taken up after incorporation.

ROCKHAM, S. D.—A telephone system has been installed at this place by Messrs. Hogeboom and McLane. It is their intention to construct rural lines in several directions.

MEMPHIS, TENN.—Within the next few months the City of Memphis is to have expended within her borders by the Cumberland Telephone & Telegraph Company not less than $125,000. This is to be entirely in the shape of new work.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company is now preparing plans and specifications for a telephone circuit to extend through the State of Mississippi, including Okolona, Aberdeen, West Point, Starksville and Columbus. When completed the circuit will be connected with the company's present circuit through the northern part of Mississippi at Tupelo, which has been the terminus of the northern circuit for the last ten years.

GRANDVIEW, TEX.—The Head Telephone Company has been organized for the purpose of establishing a telephone system at Grandview. The company has a capital stock of $20,000. T. E. Pittman is one of the incorporators.

BURKEVILLE, TEX.—The Burkeville Telephone Company has been incorporated with a capital stock of $3000, by E. F. Montgomery, C. E. Cade, J. C. Ramsey and others.

GALVESTON, TEX.—The Farmers' Telephone Company, of Wills Point, has been incorporated with a capital stock of $10,000, for the purpose of maintaining telephone lines in Van Zandt and adjacent counties. The incorporators are J. F. Sallee, A. M. Herrin and John E. Ownes.

BEAUMONT, TEX.—The Gulf & Interstate Railroad which runs from Beaumont to Port Bolivar, situated opposite Galveston, is operated by telephone. The distance is 30 miles, and there is quite a heavy traffic over the road. The road has no telegraph service whatever and the movement of trains is handled entirely by means of the telephone.

GALVESTON, TEX.—According to the direction of the City Council as conveyed in a motion adopted several weeks ago, the Southwestern Telephone Company is preparing to construct a system of underground conduits for its wires in the vicinity of the Montgomery Avenue tunnel and through that subway. The work will require an outlay of several thousand dollars.

GALVESTON, TEX.—Mr. B. S. Kimbrell, who is in charge of the hydrographic station here, has been examining the available sites around Galveston for the establishment of a wireless telegraph station, and has decided to recommend that the station be located at Fort Crockett. The funds have already been set aside for the establishment of the station, which will have a range of 500 miles.

ALPINE, TEX.—Preliminary steps have been taken to merge all of the private telephone lines in a large section of west Texas into one system and to operate it under the direction of a corporation to be organized for that purpose. The exchange will be located at Alpine from which a number of private lines will radiate. There are several hundred miles of wire, exclusive of many miles of fire fences which are used by some of the lines.

SALT LAKE CITY, UTAH.—As the result of agitation undertaken by a citizens' committee, the Rocky Mountain Bell Telephone Company has materially reduced its rates for business and residence telephones.

SPOKANE, WASH.—Charles E. Sumner, vice-president and manager of the Empire Electric Company, of Toledo, Ohio, expects to ask the City Council for a telephone franchise for an independent system in Spokane. He will agree to expend $300,000 in the next three years in construction work and will put the wires underground in the business part of the city. If he gets the franchise it will only be after a bitter struggle with the Pacific States Telephone Company.

RACINE, WIS.—The Citizens' Telephone Company is considering the installation of an automatic system.

SUN PRAIRIE, WIS.—The Interurban Telephone Company will make improvements to its exchanges and install new apparatus.

KILBOURN CITY, WIS.—The Farmers' Intercounty Mutual Telephone Company has been incorporated, capital $5000. The incorporators are D. A. Lanett, H. B. Metcalf and others.

KENOSHA, WIS.—Negotiations are pending at Kenosha for a sale of the Citizens' Telegraph & Telephone Company to a company composed of local capitalists. The price is said to have been placed at $100,000.

Electric Light and Power.

TALLADEGA, ALA.—The Talladega Electric Power Company's plant is being much improved and the line for transmitting the current to the city has been strung.

DOTHAN, ALA.—Improvements contemplated to the city electric light plant include a 250-kw revolving-field alternator, a 375-hp engine and the changing of circuits, except power from direct-current and alternating-current and the installation of 50 series enclosed arcs.

ATTALLA, ALA.—The Mayor and Board of Aldermen have granted the Etowah Light & Power Company permission to construct and maintain an electric light and power plant. A contract has also been made with the company to furnish lights for streets and stores and for the operation of the water works. It will furnish 2000-cp arc lights at 20c. per night for each all-night lamp, or at the rate of $72 per light per year.

CAMDEN, ARK.—A company composed of J. A. Van Etten, of Little Rock; W. K. Ramsey, of Camden, and others, has purchased the electric light plant and will make extensive improvements.

PINE BLUFF, ARK.—The Citizens Light & Transit Company has made several improvements to its plant in this city. A new 300-kw Bullock generator, direct-connected to a Corliss 500-hp engine has been installed, and the city is said to have one of the best equipped electrical plants in the State.

VISALIA, CAL.—Arrangements are being made by the Mt. Whitney Power Company to extend its line into the Alta district.

NEVADA CITY, CAL.—A new electric plant capable of handling the large pumps is contemplated for the Ironclad mine at Rough and Ready.

INDIO, CAL.—The Indio Light, Water & Ice Company has been incorporated with a capital of $30,000 by W. F. Everett, H. Kuhl and others.

SAN FRANCISCO, CAL.—The Culiacan Electric Company has been incorporated by Isidor Gutte, Sidney Sprout, F. G. Brane and others. Capital $300,000.

ALAMEDA, CAL.—Chas. C. Moore & Company, of San Francisco, have secured the contract for an engine and a generator for the municipal electric light plant for $12,607. The National Electric Company will furnish the 240-kw dynamo, at $888.

SAN DIEGO, CAL.—The United Light, Fuel & Power Company, of San Diego, has been incorporated with a capital of $500,000 by John D. Spreckels, of San Francisco, and others.

SAN JOSE, CAL.—The National Park Electric Power Company has been incorporated with a capital stock of $250,000. The incorporators are M. E. Page, W. H. Baugh and G. P. Bull.

NEWMAN, CAL.—The Newman Light & Power Company has been incorporated. Capital $20,000. Directors: Mrs. Annie McDonald, San Francisco; Jos. McDonald, Napa City; John G. McDonald, of Newman, and others.

SAN DIEGO, CAL.—The San Diego Gas & Electric Company is installing in its plant in this city a vertical McIntosh & Seymour engine rated at 450-hp and direct-connected to a 220-kw, 3-phase generator. The work of installing the machinery will be completed by the middle of January at an estimated cost of $35,000.

ESCONDIDO, CAL.—The land owners of the Escondido Irrigation District now own the entire water system. A company is to be formed to take over the system and other assets, and will soon commence a systematic improvement of the plant. Among these improvements will be the development of a water power plant of 400 horse-power, which will be transmittted by electricity to the city for lighting and manufacturing. The new company will be formed and ready for business in about 30 days.

SAN FRANCISCO, CAL.—The North Mountain Power Company which has its principal office at 18 California Street, San Francisco, has completed its new hydro-electric plant at Junction City, Trinity County, in record-breaking time. Ground was broken at the power site July 10, 1904, and it was promised that current would be transmitted to Eureka, Humboldt County, by Jan. 1. Besides competing with the Eureka Lighting Company's steam plant for city lighting and power, the new concern will extend its pole lines to other points in Humboldt County.

NORWALK, CONN.—The Connecticut Railway & Lighting Company advertises its intention of applying to the next Legislature for an extension of some of its charter rights and those of its constituent companies which expire July 1, 1905.

NEW HARTFORD, CONN.—Lawyer H. B. Freeman, Jr., of Hartford, and twenty others have prepared a petition to present to the incoming General Assembly applying for a charter for a new electric plant which will furnish power and light in the counties of Hartford and Litchfield.

NORWICH, CONN.—A petition is to be presented to the General Assembly at its next session by Sheriff G. O. Jackson, E. W. Higgins and C. W. Comstock of Norwich, for a charter for the Uncas Power Company to generate and transmit electricity for use in the towns of the county. The proposed plant is to be located in Norwich.

WILMINGTON, DEL.—The City Council will ask the Legislature for permission to borrow $200,000 for the construction of a municipal electric light plant.

WASHINGTON, D. C.—Bids will be received Jan. 21 by Mordecai T. Endicott, Chief of the Bureau of Yards and Docks, Navy Department, Washington, for a 29-panel switchboard in connection with power plant extension at U. S. Navy Yard here. Bids will be received Jan. 17 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Mare Island, Cal., and Puget Sound, Wash., a quantity of electric wires, cable and conduit, meters, miscellaneous electric material, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

WASHINGTON, D. C.—Bids will be received Jan. 10 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing the navy yards, Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va.; Charleston, S. C.; Key West, Fla.; Pensacola, Fla., and New Orleans, La., a quantity of motors, arc lamps, panel boards, wire, lamp cord, switches, conduit and fittings, ventilating sets, miscellaneous electrical supplies. Address H. T. B. Harris, Paymaster-General, U. S. N.

SAVANNAH, GA.—The question of constructing a municipal electric light plant is under consideration.

DOUGLAS, GA.—The Savannah Electric Light & Power Company, of Savannah, has secured the contract for constructing an electric light plant for $6250.

NEWNAN, GA.—Bonds to the amount of $20,000 have been sold to be used for the purchase of the electric light plant of the Newnan Light & Power Company.

CRAWFORD, GA.—At a meeting of the citizens of this place it was decided to light the town by electricity. Plans and prices were submitted and a contract closed for the installing of arc lights at an early date.

ATLANTA, GA.—Frank P. Rice, president of the Board of Water Commissioners, in his annual report recommends the construction of a direct-connected electric light plant, to furnish light to the water works. The probable cost is $5000.

COVINGTON, GA.—On the morning of Dec. 27 the city electric light plant here was completely destroyed by the explosion of a boiler, the engineer of the plant being instantly killed. The force of the explosion was so great that the 80-hp boilers were hurled a distance of several hundred yards, and fragments of the building scattered over two or three acres of ground. The loss is estimated at $12,000 with no insurance.

WALLACE, IDA.—Electric power from Spokane will operate the Mammoth mill. A branch line has been brought down the canyon from the point where the line to the Morning mine leaves the main line, a 150-hp motor has been installed, and it will require but a few days more to make all the necessary changes for the operation of this large concentrator by electric power, transmitted about 100 miles.

EAST MOLINE, ILL.—P. C. Dunbar is reported interested in the construction of an electric light plant.

QUINCY, ILL.—The controlling interest in the Independent Light & Power Company, of Quincy, has been sold to a Chicago capitalist. The new manager will be N. J. Ferris, of Chicago.

CHICAGO, ILL.—The Georgetown Electric Company has been organized with a capital of $15,000 to operate a heat, light and power plant. The incorporators are W. F. Brugman, A. M. Searle and C. C. Travis.

CLAYTON, IND.—Steps have been taken to secure an electric light plant in this city.

RIVERSIDE, IND.—The Muncie Electric Light Company, of Muncie, has secured the contract for lighting Riverside for 5 years at $50 per light per year.

ZIONSVILLE, IND.—An electric light plant will be installed in this town, the power to be furnished by the Indianapolis & Northwestern Traction Company. A sufficient number of arc lamps will be purchased to light the town.

INDIANAPOLIS, IND.—The Indianapolis Light & Power Company and the Marion County Hot Water Heating Company have merged into a single corporation to be known as the Indianapolis Light & Heat Company. The company will manufacture and sell electricity for light and power and will furnish hot water heat in the city of Indianapolis. The capital stock of the new company will be $1,000,000.

CHARITON, IA.—The City Council has purchased a new alternating dynamo and will be able to run the water works by a large electric motor next spring when the system is installed. The entire system will be remodeled, many of the main wires having been either totally destroyed or badly damaged by the big fires last winter and spring.

MUSKOGEE, I. T.—The Commercial Club, of Muskogee, has undertaken to utilize the great power in the falls of the Grand River, 10 miles from this point. Engineers have been employed to definitely locate the best location for a power-house and as soon as the plans can be completed the Commercial Club will undertake to finance the deal.

IOLA, KAN.—It is proposed to increase the boiler capacity of the city water and light plant. Lute P. Stover is city engineer.

GALENA, KAN.—The Spring River Power Company, composed of Chicago parties, has completed a large cement dam across Spring River at this place, and a test of the water pressure has been made. Electric power will be generated for mining work. The improvements made by the company amount to more than $500,000.

MARKSVILLE, LA.—This city will purchase the private electric lighting plant and install a water works system in connection therewith. I. W. Sylvester, of Alexander, has been retained to prepare plans and specifications.

BANGOR, ME.—Action has been taken to consider the advisability of increasing the lighting plant. M. H. Rideout is city electrician.

BALTIMORE, MD.—The United Electric Light & Power Company has purchased a majority of the stock of the Consolidated Gas Company, which is the first step in the plans which contemplate a consolidation of the United Electric Light & Power Company and the Consolidated Gas Company, of Baltimore. Negotiations which have been pending for several weeks have been conducted by Mr. S. Davies Warfield, president of the Continental Trust Company, of Baltimore.

SNOWHILL, MD.—The electric light plant is about to be enlarged to 1800 lights capacity and two 46-kw direct-current generators will be added.

BOSTON, MASS.—The Common Council and the Board of Aldermen have passed an order authorizing the city to construct or lease or maintain one or more plants for the manufacture and distribution of gas and electricity.

CHICOPEE, MASS.—In the annual report the electric light department shows that the plant and equipment have increased in value $66,420 since it was first operated. The income from city arc lights shows an increase yearly, with $653 for this year's net over last year. There are 188 street arc lights.

SPRINGFIELD, MASS.—Plans are being made by the United Electric Light Company for an equipment of sufficient capacity to furnish all the electricity needed for lighting and power purposes throughout its system, from its steam plant located at the foot of West State Street. The company has recently increased its power there by the addition of a new turbine engine of 1500 horse-power, the first of this type to be introduced in Springfield. The company has since placed orders for two more turbines, and for 1900 horse-power in new boilers.

MARCELLUS, MICH.—Another engine will probably be installed at the municipal electric light plant.

CRYSTAL, MICH.—A larger generator and a boiler will be installed at the electric light plant. Otis A. Sanford is the owner.

SAUGATUCK, MICH.—Chas. Floyd and B. Van Raalte, Jr., have secured a franchise to construct and operate an electric light and power plant.

BIRMINGHAM, MICH.—The Birmingham Gas Company has been organized to construct and maintain gas and electric light works in Birmingham: capital, $15,000. The stockholders are John T. Holmes, Clay C. Cooper and Ralph T. Aldrich, all of Detroit.

GRAND RAPIDS, MICH.—Articles of association have been filed by the Grand Rapids-Muskegon Water Power Electric Company with a capital of $1,000,000 to build one or more dams on Muskegon River, to generate electricity and to deliver this for commercial purposes in Grand Rapids, Muskegon, Big Rapids and other places. Directors: Thos. Huma and David D. Erwin, of Muskegon; W. A. Foote, of Jackson; John E. Moro, of Grand Rapids, and others.

ALPENA, MICH.—A deal has been closed by which Frank W. Fletcher, George P. Smith and others secured control of the Alpena Electric Light Company, the Alpena Water Company and the Thunder Bay Boom Company, buying out the interests of W. H. Johnson. These companies will be merged into a new company, to be known as the Alpena Power Company, with a capital stock of $500,000. The new company controls all the water privileges of the Thunder Bay river, and is organized for the purpose of supplying cheap electric power to Alpena manufacturers, as well as continuing the business of the old companies.

FT. SNELLING, MINN.—Bids are wanted Jan. 21 for constructing an addition to electric system at this post. Address R. M. Schofield, Constructing Q. M., St. Paul.

MINNEAPOLIS, MINN.—The City Council has granted the Minneosta Power & Trolley Company a 30-year franchise to maintain and operate a plant for supplying electric energy for power and light.

DULUTH, MINN.—The National Railway Contracting Company, of Boston, Mass., has secured the contract for the development of the water power of St. Louis River for the Great Northern Power Company, of which C. A. Duncan, of Duluth, is president, and Francis A. Cockefair is chief engineer.

McCOMB, MISS.—The McComb City Electric Light & Power Company, of McComb, has been incorporated, with a capital of $50,000.

STURGEON, MO.—The Board of Aldermen has appointed a committee to consider the advisability of bonding this city for the installation of an electric light plant.

ST. LOUIS, MO.—Another reduction in the cost of lighting the city institutions by the municipal lighting plant is contained in the report of the chief engineer to the president of the Board of Public Improvements. The reduction becomes plain when it is considered that less than four years ago the city was paying 13½ and then 7½ cents per kilowatt-hour for light, and is now paying more than 5 per cent. for light to other city buildings. The engineer's report for the month of December shows that the city is receiving the same light at the rate of 1.058 cents. In this way the engineer who devised the plant and installed it in the new City Hall has notified the Board of Public Improvements that the plant, which cost $35,000, will have paid for itself in less than a year out of the difference in the cost of light. The president is sanguine of the installation of the new central lighting and heating station to supply the House of Refuge, Poorhouse, Insane Asylum and Female Hospital on which site the new City Hospital is now being erected. Friends of municipal ownership are enthusiastic over the showing of the lighting plant.

NORFOLK, NEB.—The Sugar City Cereal mills has secured a franchise to install an electric light plant.

TECUMSEH, NEB.—The village of Crab Orchard is now lighted by electricity, which is furnished by a home company.

GERING, NEB.—G. L. Shumway, of Scotts Bluff, proposes constructing an $85,000 power plant on North Platte River, near Gering.

ASBURY PARK, N. J.—Jesse W. Starr is about to petition the Council for a franchise for a gas and an electric light plant.

STRATFORD, N. J.—Extensions of the electric light system of the Clementown Township United Electric Company are being made to this place, Kirkwood and Lindenwold.

HAMMONTON, N. J.—The Hammonton Electric Light Company, of Hammonton, has been incorporated, capital $50,000. Incorporators: H. E. Woodman, C. E. Starr and F. P. Reed, of Hammonton.

COHOES, N. Y.—Chas. H. Van Auken, engineer of the electric light works, is preparing plans for increasing the capacity of the plant.

NEW YORK, N. Y.—Bids are wanted Jan. 16 for furnishing material and wiring the quartermaster's warehouse and wharf buildings, installing electrical apparatus, etc., at Governor's Island. Address Maj. G. S. Bingham, Quartermaster, U. S. A., Army Building, New York.

NIAGARA FALLS, N. Y.—The Common Council has granted permission to the Niagara Falls Gas & Electric Light Company to build conduits in the streets and the Niagara, Lockport & Ontario Power Company has secured a franchise to put up poles and string wires and build conduits.

NEW YORK, N. Y.—The Northern Westchester Light & Power Company has been incorporated with a capital of $5000, by R. S. Hull, Brooklyn; Alex. S. Andrews, Flushing, and John Larkin, of New York City, to conduct a lighting business in Cortlandt, New Castle, Ossining, Pleasantville, Briar Cliff Manor, Croton and Tarrytown.

CHARLOTTE, N. C.—The Factory Site & Power Company, which was incorporated at Waynesville lately, with a capital of $300,000, is now transmitting 500 horse-power of electricity and will soon have 1500 horse-power more for the use of cotton mills and other factories in its neighborhood.

MIAMISBURG, OHIO.—Chas. F. Eck, city clerk, writes that $19,000 bonds are to be issued for the purpose of merging the electric light plant and water works.

FOREST GROVE, ORE.—Interests of E. W. Haines and others in the electric light plant and mill have been taken over by the Haines Electric Power Company, of Forest Grove. E. W. Haines, John Thornburg, C. W. Nottingham and J. Frank Watson are the incorporators. Capital $50,000.

BARBERTON, OHIO.—A new electric lighting plant may be installed in Barberton in a short time. The Barberton Inn owners, O. C. Barber, of Akron, and M. J. Alexander, of Pittsburg, hold a franchise granted them about a year ago by the Council which gives them the right to install an electric lighting plant and to wire the city. The plant of the Barberton Inn, which furnishes all the light for the big hostelry, is now being run at only an eighth of its capacity, and it could alone light and furnish electricity for the downtown section of the town. The plan is to install a bigger plant at the Inn and to compete with the Northern Ohio Traction & Light Company.

NEW MILFORD, PA.—The New Milford Light & Power Company will expend about $4500 for improvements and bids will be received at once.

PITMAN GROVE, PA.—The plant of the Pitman, Clayton and Glassboro Electric Light Company has been sold by the receiver, David O. Watkins, of Woodbury, to M. K. Treichler, of Philadelphia, for $20,000.

TAMAQUA, PA.—The Town Council has awarded to John F. McGinty and E. M. Shepp the contract for lighting the town by electricity for a period of 10 years at $60 per light per year. They will commence constructing their plant in the spring and will be ready to take up their contract on Jan. 1, 1906.

YORK HAVEN, PA.—The York Haven Light & Power Company has procured a 60-day option on the plant of the Steelton Heat & Electric Light Company, which furnishes light and heat to the borough of Steelton and the adjoining town of Oberlin. If the deal for the Steelton plant is finally consummated, it is proposed to furnish its power from the York Haven plant.

NEWPORT, R. I.—Bids will be received Jan. 24 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for installing an electric light system, etc., in U. S. Naval Training Station here.

SUMTER, S. C.—The Sumter Light & Railroad Company has secured a franchise for an electric light plant.

MARION, S. C.—The Carolina Water, Light & Power Company with $250,000 capital stock, proposes to construct water, light and power plants in Marion.

COLUMBIA, S. C.—The Carolina Water, Light & Power Company has been incorporated with a capital of $250,000. J. W. Johnson and W. J. Montgomery are the incorporators.

LOCKHART, S. C.—The Broad River Water, Light & Power Company, of Lockhart, has been chartered by the Secretary of State, with a capital stock of $1,000,000. J. L. David is president, P. J. Balaguer and E. W. Wynne vice-presidents and M. V. Haselden, secretary and treasurer.

DALLAS, TEX.—The Dallas Electric Light & Power Company contemplates building a new power house.

MINERAL WELLS, TEX.—The Mineral Wells Electric Light, Power & Heating Company, of Mineral Wells, has been incorporated, with a capital of $50,000. Incorporators: V. E. Lycan, of Edna, Mo.; D. G. Galbroth and Wm. D. Williams, of Fort Worth.

BURLINGTON, VT.—The construction of a municipal electric light plant has been begun in this city. The building is already completed, and the plant, complete, will cost about $60,000. It will furnish about 200 arc lights, light all of the city buildings and will, in addition, have about as much additional power for commercial uses.

ABERDEEN, WASH.—The Ninemire & Morgan Company has petitioned for a franchise for an electric light and steam-heating plant.

SEATTLE, WASH.—The power station of the Cedar Lake municipal plant is now complete and is ready to supply light to the public buildings and streets of Seattle.

BLAINE, WASH.—The Council is considering the establishment of a city lighting plant. A stock company may be formed by local parties to install such a plant.

MANITOWOC, WIS.—The West Side Electric Company has secured a franchise, and will at once construct an electric plant, to cost about $200,000.

CALGARY, N. W. T.—The ratepayers of Calgary have decided in favor of installing a municipal electric lighting system in the town.

CAMPBELLFORD, ONT.—It is proposed to install at the city electric light plant 2 units of 800-kw each, direct-connected; speed 200 r.p.m. W. J. Doxsee is chairman of the waterworks and electric light commissioners.

OTTAWA, ONT.—Application will be made to the Dominion parliament, at its coming session, bl the Niagara-Welland Power Company for an act authorizing the company to use its proposed canal for navigation purposes; to construct a tramway along its right of way, and to extend the time for completion of its works.

The Electric Railway.

TUSCUMBIA, ALA.—The Sheffield Company, controlling the electric railway and public service interests in this vicinity, has incorporated, under the laws of Alabama, to comply with State statutes. The capital is $1,000,000. The company was originally incorporated under the laws of New Jersey.

SANTA CLARA, CAL.—The Santa Clara Interurban Railway Company has been incorporated by J. C. Campbell, W. H. Netson, J. E. Parkinson and others. The capital stock is $5,000,000.

SAN JOSE, CAL.—The Town Trustees of Mountain View have granted J. F. Parkinson the right to build an electric railway through the main streets of the town. Mountain View is on the route of the proposed electric trunk line from San Mateo to Gilroy, which the Parkinson Company is preparing to build.

WILLIMANTIC, CONN.—The next Legislature will be asked to grant a charter for an electric railway from Willimantic to Stafford.

NORWALK, CONN.—A petition will be presented at the January session of the General Assembly, asking that body to grant to William Wardwell, of New Canaan, and others, a charter to build an electric railway to connect Norwalk, New Canaan and Ridgefield. The company also seeks the right to do a general power business.

SPRINGFIELD, ILL.—The Springfield-Xenia Traction Company has been sold at receivers' sale to A. C. Hanson, of Cleveland, Ohio.

SWEETWATER, ILL.—Articles of incorporation have been filed with the County Recorder for the Springfield, Sweetwater & Peoria Electric Railway Company, with a capital stock of $2500.

INDIANAPOLIS, IND.—The Consolidated Traction Company has increased its capital stock from $300,000 to $1,500,000, an amount sufficient to complete the construction of the road. The directors have decided to continue the road west to Covington and Danville.

GOSHEN, IND.—A merger which consolidates the Indiana Railway Company, operating interurban lines between Goshen, Elkhart, Mishawaka and South Bend, and South Bend and Niles, Mich., with the Indiana Western Railway Company, which is constructing a line west from South Bend, touching Chain Lakes, New Carlisle, Laporte and Michigan City, has just been effected and has a most important bearing on electric railway interests in Northern Indiana. The Consolidated has also started the building of a line from Niles, Mich., to Buchanan, Mich., and thence on to Benton Harbor and St. Joseph, Mich. The consolidated companies have a capitalization of $3,000,000, and provision is made for issuing bonds to pay off indebtedness and add to the equipment, the bonds running fifty years. The directors are Arthur Kennedy, of New York City; J. McM. Smith, of South Bend; Wilber L. Stonex, of Goshen; James B. McCance, of South Bend, and Walter Lyon, of Pittsburg, Pa.

ELDORA, IA.—An interurban line is to run from this city to the Capital.

BIDDEFORD, ME.—The Biddeford Pool Electric Railway is said to have been financed. Charles E. Atwood is treasurer of the company.

PORTLAND, ME.—The Railroad Commissioners have approved the articles of incorporation of the Bridgton Street Railway Company, which is to operate a road 1½ miles long in Bridgton. The plant is to operate in the summer only.

BOSTON, MASS.—Through-car service between Winchester, Woburn and the Sullivan Square Terminal of the Boston Elevated Company at Charlestown, Mass., is scheduled to begin on Jan. 15.

CONCORD, MASS.—The sale of the Concord & Boston Street Railway Company's property will be held on Jan. 28. The postponement is made in order that the creditors may have further opportunity to arrange for a satisfactory disposal of the property.

MARLBORO, MASS.—The Boston & Worcester Street Railway Company has completed its new sub-station at Marlboro, and is installing the machinery. A petition for authority to string a high-tension wire through the city to connect with this station has been held up by the Board of Aldermen, so that the station cannot be used for the present.

BOSTON, MASS.—The Taunton & Buzzard's Bay Street Railway Company has been organized, with a capital stock of $225,000, to operate the Middleboro, Wareham & Buzzard's Bay Street Railway, which was sold by the receiver Nov. 16. The Taunton & Buzzard's Bay Street Railway has petitioned the Railroad Commissioners for their approval of the issue of capital stock as fixed above.

BOSTON, MASS.—The Taunton & Pawtucket Street Railway Company has been organized, with a capital stock of $200,000, for the purpose of operating the Bristol County Street Railway, sold by the receivers Nov. 16. The company has petitioned the Railroad Commissioners for their approval of the issue of capital stock as fixed above.

ATTLEBORO, MASS.—J. T. Burnett and J. L. Hall, of Boston, receivers of the Bristol County Street Railway, have sold the road at auction to J. A. Arnold, of Pawtucket, for $30,000. The sale is subject to a mortgage of $250,000, held by the Federal Trust Company, trustee, for the holders of $200,000 bonds and charges. Arnold, who was the only bidder, purchased the property in behalf of himself, C. M. Choate, Jr., of Boston, and G. H. Newhall, of Providence, who, it is understood, are to operate the line.

BOSTON, MASS.—The State Railroad Commissioners have authorized the consolidation of the Worcester & Southbridge, the Southbridge & Sturbridge, and Worcester, Rochdale & Charlton Depot Street Railway Companies, the controlling interest in all of which has been acquired by the New York, New Haven & Hartford Railroad Company. The new system, which will be known as the Worcester & Southbridge Street Railway Company, has permission to increase its capital stock by $100,000, to be used in purchasing the outstanding stock of the Southbridge and the Sturbridge & Charlton Depot roads on a share-for-share basis. The original Worcester & Southbridge Road and the Charlton Depot Company went into the hands of receivers about a year ago, but were subsequently reorganized.

ST. PAUL, MINN.—The St. Paul Street Railway Company has appealed to the Supreme Court from Judge Kelly's decision in the suit of the State to collect delinquent personal property taxes for 1903. The State Board of Equalization raised the assessment on the company's personal property to $3,128,758, an increase of $1,000,000, and the company refused to pay the tax, claiming that the State Board did not have the power to make the increase. Judge Kelly decided that the action of the State Board was legal.

MISSOULA, MONT.—It is stated on apparently reliable authority that the Clark syndicate, of Butte, Mont., controlled by Senator W. A. Clark, proposes to erect a plant and operate an electric railway system in this city.

GLENDIVE, MONT.—The Glendive & Lower Valley Transit Company has before the County Commissioners a petition for a franchise to construct an electric railway between this city and Buford, N. D., a distance of 80 miles. The proposed line will extend through the Lower Yellowstone Valley.

JEFFERSON CITY, MO.—A bill has been introduced in the General Assembly giving four hours on a street car transfer. The bill would also compel all street car companies in the State to give transfers on all their connecting lines and branches.

MIDDLETOWN, N. Y.—A judgment of foreclosure and sale involving the Middletown-Goshen Electric Railway, has been obtained before Justice Dickey, in Brooklyn, by the trustee, the Farmers' Loan & Trust Company, of New York City.

NEW YORK, N. Y.—Chief Engineer Lewis, of the Board of Estimate, has proposed six plans for providing an adequate approach to the Williamsburg Bridge, on the Brooklyn side, and the Board will probably adopt one of these in the near future. There is to be a hearing on all six plans before the Board of Estimate on Feb. 3. One of Mr. Lewis' schemes is to extend Grand Street, from Hooper Street to Havemeyer and South Fourth Streets, at a cost of $756,000; another, to extend Montrose Avenue, from Union Avenue to Broadway, at a cost of $268,000, and a third to extend Bedford Avenue, from Heyward Street to the southeast corner of the Williamsburg Bridge plaza, at a cost of $1,480,000. Mr. Lewis also proposes to widen Roebling Street, between South Fourth Street and Union Avenue, from 60 ft. to 80 ft., at a cost of $582,000, with an alternative scheme to widen it between the same limits, at a cost of $718,000. Mr. Lewis' sixth plan is to widen and extend Roebling Street to 86 ft. from Broadway to Lee Avenue, at a cost of $200,000.

RALEIGH, N. C.—The Raleigh & Durham Passenger & Power Company, which plans to build a line from Raleigh to Durham, has been granted a franchise by the City Council of Raleigh.

WILMINGTON, OHIO.—W. D. Riddell, chief promoter of the Wilmington & Hillsboro Traction Company, states that arrangements have been completed for financing the enterprise and that the road will undoubtedly be built next spring.

DAYTON, OHIO.—The Dayton & Northern Traction Company has increased its capital stock by an issue of $100,000 5 per cent. preferred stock. The action was taken to pay off an indebtedness incurred at the time of the construction of the road.

WAPAKONETA, OHIO.—It is announced that the Sandusky Southwestern Railway Company has arranged with New York bankers for the financing of $5,000,000 worth of bonds. Considerable construction work has already been done on this property.

ZANESVILLE, OHIO.—The Security Trust Company, of Wheeling, W. Va., has arranged for the financing of the Southeastern Ohio Railway, Light & Power Company, of Zanesville. Capital to the amount of $600,000 has been furnished. Valuable coal and oil fields will be opened up by the road. Construction work is to start in the spring.

CLEVELAND, OHIO.—The Buckeye Street Railway Company has been incorporated, with $1000 capital stock, by J. H. VanDervere, Edward H. Tracey, S. D. Reed, Davis Hawley and J. E. Chadwick. The officers of the company state that they expect to build a line from Canton to Akron.

CLEVELAND, OHIO.—The Terminal Construction Company, of Cleveland, has been incorporated by F. W. Green, N. B. Wood, J. R. Zmunt, W. A. Bennett, D. Gindelsperger and others. The capital stock is $10,000. The object of the company is to build an entrance into Cleveland for a new interurban line to Akron, on which the promoters have been working for some time.

HARRISBURG, PA.—The Kennerly Coal & Coke Company, chartered with a capital stock of $1,000,000, to do business in Somerset County, with headquarters in Johnstown, proposes to build an electric railway to Bear's Creek, there to connect with the lines of the Johnstown Passenger Railway Company.

HARRISBURG, PA.—The charter for the proposed Mahanoy City & Tamaqua Street Railway Company has been granted, notwithstanding the protests of the Schuylkill Traction Company. The latter company has leased the Lakeside Railway Company, and claims that the latter has a charter for the same route as the new company. It was claimed, however, that the failure of the Lakeside Company to begin work on the construction of the road within the time limited by law caused an abandonment of its right The construction will be begun in the spring.

CHATTANOOGA, TENN.—Application will be made at once under the laws of Georgia for a charter for the Tennessee-Georgia Interurban Railroad Company, with a capital stock of $300,000, with privilege of increasing to $500,000. The company will be formed to construct and operate an electric railway between Chattanooga and Ducktown, Tenn., via Ringgold, Catoosa and other nearby Georgia points. The incorporators will be S. W. Divine, of Chattanooga; J. H. Walker, Jr., J. C. Brian, J. R. Jones, W. E. Biggen, J. M. Robinson, J. R. Bryan and J. W. Clark, of Catoosa County, Georgia.

SAN MARCOS, TEX.—Judge B. G. Neighbors, an attorney of Hays County, is said to have secured financial backing for building an electric railway from San Marcos along the river, and terminating at Luling, on the Southern Pacific Railway.

FAIRMOUNT, W. VA.—The Fairmount & Clarksburg Traction Company plans to extend its lines.

RACINE, WIS.—This city has granted a contract to the Milwaukee Electric Railway & Light Company for furnishing street lights.

MILWAUKEE, WIS.—John I. Beggs, president of the Milwaukee Electric Railway & Light Company, is quoted as saying that it is the intention of the management of his company to build an electric line from Waukesha to Oconomowoc, but that it has not definitely decided when to build.

KENOSHA, WIS.—Suit has been brought in the United States District Court by Patrick-Haynes, Gustav L. Clausen and Arthur M. Einstein, all of Chicago, asking for the appointment of a receiver for the Kenosha Electric Railway Company.

New Industrial Companies.

THE EXMOOR STORAGE BATTERY COMPANY, located at Phoenix, Ariz., has been incorporated in Illinois with a capital of $10,000.

THE BULLOCK ELECTRIC COMPANY, of Cincinnati, has been incorporated with a capital stock of $2,500,000 to manufacture electrical machinery.

THE RICHARD E. PEDIGO COMPANY of Chariton, Iowa, has been chartered to manufacture the Pedigo Lightning Arrester and Telephone Cut-Out. The authorized capital is $10,000.

THE REO MOTOR CAR COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are R. E. Olds, Ciprian Andrade, Jr., and R. M. Owen, of New York.

THE WIRELESS TELEGRAPH EXPLOITATION COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are J. R. Taylor, J. L. Lotsch and R. M. Dyer, New York.

THE WESTFALL TELEPHONE COMPANY, Grayville, Ill., has been incorporated with a capital of $4000 to operate a telephone system. W. F. Westfall, Claude O. Ellis and Nathan March are the incorporators.

THE CONSUMERS METER TESTING COMPANY, Chicago, Ill., has been incorporated with a capital of $5000 for testing meters and machinery. W. H. Hanna, H. T. Winston and Edw. C. Lovett are the incorporators.

THE MANHATTAN & BRONX ELECTRIC COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are Willis B. Richards, John S. Clark and James C. Stafford, of New York.

THE ARDSLEY MOTOR CAR COMPANY, of Yonkers, has been incorporated with a capital stock of $75,000. The directors are Theodore S. Fuller, Frederick P. Fuller, New York, and A. E. Rittenhouse, Newark, N. J.

THE KOKOMO ELECTRICAL CONSTRUCTION COMPANY, of Kokomo, Ind., has been incorporated with a capital stock of $20,000. The names of the incorporators are G. W. Norwood, C. O. Scott and George H. Martzolf.

THE WEEHAWKEN AUTOMOBILE COMPANY, of Weehawken, N. J., has been incorporated with a capital stock of $3000. The incorporators are Joseph W. Shellborn, Albert Lenly, Joseph L. Shellborn and Frederick R. Shellborn.

THE GEORGETOWN ELECTRIC COMPANY, of Chicago, has been incorporated with a capital stock of $15,000 for the purpose of supplying heat, light and power. The incorporators are W. F. Bruggman, A. M. Searle and C. C. Travis.

THE INTERNATIONAL MICROPHONE COMPANY, of Kittery, Me., has been incorporated with a capital stock of $5,000,000. The officers of the company are: President, Horace Mitchell, Kittery; treasurer, A. M. Meloon, Newcastle, N. H.

THE PRATT ELEVATOR SAFETY COMPANY, of New York City, has been incorporated to manufacture elevator safety devices. Capital stock, $50,000. The directors are C. W. Preston, Kingston, and S. F. Taylor and C. R. Pratt, New York.

THE ARIEL MOTOR CAR COMPANY, of Boston, has been incorporated with a capital stock of $100,000. The officers of the company are: President, Chas. B. Lamont, New Dorchester; treasurer, Chas. J. Palmer, Boston; clerk, Joseph P. Alcott, Boston.

THE WESTERN TELEGRAPHONE & TELEGRAPHEX COMPANY, Chicago, Ill., has been incorporated by Robert P. Jack, Hermann W. Danforth and W. T. Irwin. The new company which is capitalized at $60,000 will manufacture telephone and telegraph instruments.

THE ROSSMAN ELECTRIC COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $40,000. The concern will begin business with a cash capital of $5000. The directors are G. B. Rossman, New York; Frank A. Ward, and F. H. Ward, Rochester.

THE SOUTHERN ELECTRIC COMPANY, of Wilmington, N. C., has been incorporated with a capital stock of $4000. The purpose of the corporation is to manufacture electric supplies, construct light and power plants, etc. The incorporators are J. O. Brock, John Hall and L. E. Hall.

THE AUTOMATIC SWITCHBOARD & TELEPHONE MANUFACTURING COMPANY of Elkhart, Ind., has been incorporated. The company is to buy and sell automatic switchboards, telephones and other electrical devices. The capital stock is $10,000. The first five directors are Isadore J. Kusel, Harry J. Kusel, Harry C. Randall, Edgar L. Kerstetter and George W. Brown. The principal offices will be in Elkhart.

Legal.

SPRING JACK PATENTS SUSTAINED.—The Court of Appeals of Cincinnati has sustained the claim of infringement brought by the Western Electric Company against the North Electric Company, of Cleveland, Ohio, on three patents granted to Scribner and Warner, relating to spring jacks. Barton and Tanner, of Chicago, were attorneys for the plaintiff.

MISSISSIPPI VALLEY TELEPHONE LITIGATION.—The recent change of ownership and reorganization of the Mississippi Valley Telephone Company has resulted in litigation of considerable magnitude. In the district court of Lee County, Iowa, J. C. Hubinger has filed a suit in equity against John E. Andurs, Samuel S. Thorpe and Thomas Peebles, claiming that he had been defrauded in his dealings with the defendants; asking for an accounting and judgment for $225,000 if the court should find that the defendants wrongfully converted the property of the Mississippi Valley Telephone Company, and under duress, to their own use.

CONTRACT BETWEEN TELEPHONE COMPANIES.—A decision of wide importance to the Independent and Bell telephone interests has been handed down by Judge Brennan, of Des Moines, Ia., in which he sustained the injunction of the Boone County Telephone Company against the Farmers' Mutual Company, of Grimes. The injunction compels the latter to fulfill its contract for a period of years with the Boone County company. Incidentally the decision, it is said, prevents small independent telephone companies breaking their contracts with the mutual toll system and connecting with the Bell lines which offered better facilities. The Grimes Company, it is stated, attempted to abrogate its contract and connect up with the Bell system. Then the Boone County Telephone Company filed a petition asking an injunction restraining the Grimes company from disconnecting with its line or connecting with any competitive lines. It alleged that the subscribers had, by the contract with the Grimes Company, a vested right to the benefits of the connections with the large number of subscribers on its lines. They could not estimate the value of this and consequently the only equitable way of settling the difficulty was by compelling both to fulfill the contract.

Educational.

PURDUE UNIVERSITY.—The Italian Commissioner-General of the Louisiana Purchase Exposition has presented to Purdue University a fine collection of charts and paintings that were on exhibition in the Palace of Electricity at the World's Fair. The collection shows the development of the electric power-transmission plants in Italy and is presented to the Electrical Engineering Department of Purdue as a compliment to Prof. Goldsborough who was at the head of the department of electricity.

Personal.

MR. ALEXANDER WEBB, of New York, has been elected treasurer of the Youngstown, Ohio, Consolidated Gas and Electric Company, to succeed Mr. L. C. Root, who resigned recently.

MR. CHARLES E. PHELPS, electrical engineer, of Baltimore, has, it is said, been brought over to New York to help Conptroller Grout get his gas and electric lighting figures straight.

MR. F. C. TOEPLEMAN, general manager of the Home Telephone and Telegraph Company, Henderson, N. C., received on Christmas Day from the employes of the entire system, a magnificent leather-covered rocking chair.

MR. CAMPBELL SCOTT, who resigned on Jan. 1 the position which he long held, of secretary and general manager of the C & C Electric Company, has temporarily taken an office in room 1630, No. 150 Nassau St., New York, for use while his plans for the future are being matured.

MR. E. H. DAVIS, of Williamsport, Pa., president of the National Electric Light Association, was in New York City this week on affairs connected with that body. Mr. Davis is hard at work on the programme and on reports from important committees. The outlook for the Denver-Colorado Springs meeting is splendid.

MR. W. S. KEMP, who has been connected with the Brookline National Bank for the last ten years as cashier, has become associated with the Holtzer-Cabot Electric Company, of Boston, Mass., assuming the duties of secretary and treasurer, a position made vacant by the resignation of the former treasurer, Mr. Ira A. Foster.

MR. ALFRED J. THOMPSON, who for some time past has represented the Crocker-Wheeler interests in the vicinity of New York, and for a time in Cuba, and who was also formerly with Edeson Manufacturing Company interests, has joined the forces of the Allis-Chalmers-Bullock combination and will devote his attention to Bullock light and power apparatus in the New York district, where he has a large and wide acquaintance.

MR. J. P. GILLETTE.—Joseph P. Gillette, of New London, Conn., local manager for the New England Engineering Company, has tendered his resignation for the purpose of associating himself with Wheeler H. Vibber in a new company which is to be formed for electrical construction and light manufacturing. Mr. Vibber has been in the employ of the New England Engineering Company until recently, when he gave up his position to arrange for the new enterprise. The company will have backing from local capitalists.

MR. CHARLES CHURCHILL, managing director of Charles Churchill & Company, Ltd., of London, who was the pioneer introducer of American labor-saving devices on the other side, is now on a short visit to the States. The Churchill Company represents the British interests of upward of one hundred American manufacturers of machine tools. The turnover last year exceeded $2,000,000. While here, Mr. Churchill is making his headquarters at the offices of E. L. Reichhelm & Company, 23 John Street.

MR. E. KLAPP.—Mr. Eugene Klapp, who, for some time, was the engineer in charge of the fourth division of the work of the New York Rapid Transit Commission, has been appointed consulting engineer of the Brooklyn Rapid Transit Company. He is a graduate from the Columbia School of Mines. In 1889 he became chief engineer for the South Side Elevated Railroad in Chicago. In the Spanish war he was a captain in a volunteer regiment of engineers. After the war he became the manager of the National Construction Company, which built the drainage plant for New Orleans.

MR. HUGH L. COOPER, chief engineer and manager of construction of the Mexican Light & Power Company, Ltd., which is building the 45,000-hp Necaxa-Mexico City-El Oro power transmission system, has resigned his position in order to devote his entire attention to the installation of the Niagara Fall (Canadian side)-Toronto system and other important projects in the United States and Canada. Before re-commencing work he will take a two months' trip to Europe. Mr. F. S. Pearson, vice-president and consulting expert of the Mexican Company, is now in the Southern Republic looking over the construction of the system.

MR. J. W. MUMPER, a local electrician, has been awarded the contract for lighting the streets of Hanover, Pa. Other competitors were the Hanover Light, Heat & Power Company, and the Welsbach Company, of Philadelphia. The Hanover Light, Heat & Power Company offered to light the streets from dusk until midnight for $60 per light. The Welsbach people offered their gas lamps on an all-night service for $35 per lamp, while the Mumper bid was for 2000 candle power electric lights on an all-night service at $64.92, provided he be given a ten-year contract. The borough councils decided that this was the lowest bid, and a formal motion was adopted that a contract be entered into with Mr. Mumper. He will be required to give a bond in the sum of $5000 for the faithful performance of his side of the agreement.

MR. E. KILBURN SCOTT, M. Inst. E. E., A. M. Inst. C. E., as noted briefly last week, has been appointed to organize and take charge of the Electrical Engineering Department at Sydney University, Australia. In addition to lecturing duties, he will continue his consulting practice. Mr. Scott is a native of Leeds, England, but his grandfather, Thomas Scott, was a wool merchant in Lendall Lane, now Exchange St., Boston, Mass., in 1815. Mr. Scott is recognized as an expert in dynamo design, transmission of power work, central station design, and traction work. He has for years advocated alternating current traction and was the first to publish a book on the subject of electric driving in factories. Mr. Scott is also a business man, having had considerable commercial experience with Johnson & Phillips, and as manager in the United Kingdom and Colonies for the Compagnie Internationale d'Electricite of Liege. He has of recent years acted as a consultant and among other work advised on the three-phase, 10,000 volt transmission at Snowden and the railways in connection therewith, which will be the first in Great Britain to work with alternating current. He has also advised on the Sunderland and District Tramways.

MR. S. L. F. DEYO.—Some 150 members of the engineering staff of the Interborough Subway Construction Company celebrated the completion of the engineering work on the big tube at Haan's restaurant, New York, on January 10, with a dinner at which Chief Engineer Deyo was the guest of honor. The dinner givers were members of the engineering and electrical corps and their assistants, who evidenced their appreciation of their chief by presenting to him a five-gallon silver punch bowl, gold lined and embellished with engravings of the huge power house at Fifty-eighth Street and Eleventh Avenue, etc. The handles were reproductions of high-tension cables stringing together car wheels, to which Mercury wings were attached, the same flying car wheels serving as supports for the bowl. With it was a gold-lined ladle bearing in monogram the initials of the chief. Mrs. Deyo and a number of the wives of the members of the party participated in the dinner and greatly enjoyed the cheering and singing which the younger men in the corps made a feature of the evening. Gen. H. T. Douglas, First Assistant Engineer, made the speech of presentation. There were speeches lauding the work of the chief engineer and his assistants by August Belmont, president of the company; Charles F. Evans, the original secretary of the company; John B. McDonald, the contractor who built the Subway; Vice-President E. P. Bryan and General Manager Frank Hedley, of the Interborough Company, Theodore H. Pasche, of the engineering corps, and J. E. Thomas, superintendent of the main power house.

Trade Publications.

DIRECT U. S. CABLE COMPANY has issued, as usual, a neat block calendar to its friends and patrons for 1905, with daily date and space for memoranda.

MICA INSULATOR COMPANY, 218 Water Street, New York City, calls attention to the advanced cost of materials used in the production of Micanite and has just issued a new price list for 1905.

EDEY, BROWN & SANDERSON, 2 Wall Street, New York City, have just issued an excellent stock quotation record for railroads. It is very handy and useful and includes a great many street railways.

THE INDIANA RUBBER & INSULATED WIRE COMPANY, of Jonesboro, Ind., has issued a 1905 calendar in which the dates appear in white letters on a black background, thus affording a contrast to the usual calendar effect. The figures are plain and distinct. A very modest advertisement of the Paranite and Peerless wires and cables appears as a part of the calendar.

WESTINGHOUSE POCKET BOOK.—The Westinghouse Electric & Mfg. Company has issued for 1905 a handy vest-pocket diary, which is nothing less than an electrical encyclopedia in parvo. It comprises in small space a vast amount of interesting electrical data, as well as other data, and has besides space for memoranda of all kinds. There are included also maps of the United States and its dependencies.

YELLOW PERIL POCKET BOOKS.—In its Christmas souvenir, a convenient card case or pocketbook of unique appearance, the Hinton Electric Company, Ltd., Victoria, British Columbia, has successfully combined utility and art. The cover is of an enduring leather, embossed with an oriental design. On a white ground a convoluted dragon—it might be a typical presentment of the "Yellow Peril" itself—is shown making an energetic progress through space, apparently not in the least disturbed by the fiery flames which play around it. The effect of the combination of colors and the vigor of the drawing is novel and striking.

THE AUTOMATIC ELECTRIC COMPANY, Van Buren and Morgan Sts., Chicago, has just issued an interesting pamphlet devoted to a technical description of its automatic telephone system operated under the Strowger patents. The ELECTRICAL WORLD AND ENGINEER has also recently had an interesting description by Mr. Meade on the latest features of this system, which, complex as it seems on the surface to be in principle and mechanism, accomplishes its results with remarkable simplicity and efficiency. What can be done may be inferred from the fact mentioned in the circular that over a new board at Grand Rapids, Mich., the traffic has been about 1500 calls established and released each five minutes, requiring an average current of from 40 to 50 amperes.

FEMCO LAMPS.—The Franklin Electric Mfg. Company, of Hartford, Conn., has issued an admirable illustrated catalogue, pocket size, devoted to its Femco incandescent lamps. Its standard 3.1, 3.5 and 4 watt lamps are well known and are here duly set forth. The reflector lamp is also given special attention. The older reflector type is shown, and new types are illustrated. One of these has a detachable opalescent shade which affords a diffused and softened light without any appreciable diminution of the reflecting power. The lamp is shown complete and in parts. Another new type is the vertical half—or one sided—form of reflector lamp, with a special base. The spring contact attached to the cap permits the lamp to be inserted in the socket in such a manner that the reflecting surface may be placed in any position desired, and the light deflected in the exact direction required by the user.

THE FRICK COMPANY, Waynesboro, Pa., has just issued a handsome and interesting pamphlet with regard to its Eclipse triple pipe brine cooler, containing information also in respect to its ammonia condenser. This condenser is of a special design intended to take care of the ammonia gas discharged from a refrigerating machine and taking up the latent heat of vaporization, plus part of the heat generated by compression. Its use is especially recommended where the condensing water is to be used for other purposes, and it is available at circulating pressure at discharge from the condenser without change except in an increase in the temperature. The absence of drip and of dampness adapts this style of condenser to all locations. The pamphlet states that the Frick Company is building three styles of ammonia condensers; the surface or straight pipe open air, the submerged coil in circular tank, and the Eclipse.

News of the Trade.

THE McCULLOUGH-DALZELL CRUCIBLE COMPANY, Pittsburg, Pa., which is manufacturer of articles containing plumbago, including crucibles, stoppers, etc., has sent out a small crucible mounted on a wooden base which is attractive in appearance and which might be useful as a match holder. It is an article of utility as well as proving an advertisement for the makers.

THE NATIONAL-ACME MANUFACTURING COMPAY, Cleveland, Ohio, announces that its western office, A. B. Breeze, manager, has been removed from 166 Lake St. to 63 South Canal St., Chicago, Ill., more commodious quarters being required to take care of its increasing trade in that territory. It has also increased its working force, placing Mr. J. T. Donahue in that territory as assistant to Mr. Breeze.

OIL FILTERS.—The Burt Manufacturing Company, Akron, Ohio, has just made a shipment of 21 of its oil filters to its agency at Havana, Cuba. It reports that, according to present conditions, Cuba will afford a very profitable field for American manufacturers. It has also worked up an extensive export trade in many other countries and has recently made a shipment of 9 oil filters and 6 exhaust heads to its agency at Sidney, Australia; 18 oil filters to its agency at St. Petersburg, Russia; 3 filters to its agency at Calcutta, India; 4 filters to Spain, and two 20-inch exhaust heads to its agency at London, England.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, reports a very brisk demand for small exchange switchboards of the type usually known as private branch exchange switchboards. Four equipments of this kind have recently been shipped to Topeka, Kan., and one equipment to Fort Worth, Tex. Among the recent shipments of small exchange switchboards of the magneto call type, the following destinations are given: Brookville, Kan., one 100-line switchboard; Hamilton, Ga., one 100-line switchboard; Atkins, Ark., one 100-line switchboard; Tallahassee, Fla., one 100-line switchboard; Waverly, Ill., one 100-line switchboard; Berne, Ind., one 100-line switchboard; Lebanon, Ind., one 100-line switchboard.

IMPROVED LABORATORY APPLIANCES.—The World's Fair judges have awarded the F. W. Braun Company, of Los Angeles, Cal., gold medals covering practically its entire line of improved apparatus and appliances for assayers, metallurgists and chemists. Its exhibit was arranged in three groups, and the highest award, a gold medal, was secured for each group. Among the medal winners were the following: Cary hydrocarbon burner, Marvel crude oil burner, Braun gas burner, Cary furnaces, Braun cupel machine, a complete line of ore crushing and pulverizing machines, Braun ore sampler. These labor saving laboratory appliances are in use in the principal educational, mining and commercial laboratories in all parts of the world. Government laboratories in the United States and foreign countries have been particularly prompt to recognize the merits of these specialties. Complete catalogue may be had by writing to F. W. Braun Company, Los Angeles, Cal.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 3, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

778,834. MEANS FOR VENTILATING ELECTRICAL MACHINES; Albert Aichele, Baden, Switzerland. App. filed Dec. 7, 1903. A casing inclosing the stator and rotor is provided with an air outlet, a forced circulation being directed through the casing from a point near the axis to the periphery and thence between the coils of the stator to and about the rotor and back between the coils of the stator and finally to the outlet.

778,877. TELEPHONY; Albert Meinema, Chicago, Ill. App. filed May 2, 1904.

778,888. HAIR DRYING APPARATUS; Otto Peter and Herbert Von K. Racoszyn, Osnabruck, Germany. App. filed July 29, 1904. A box through which the air passes is provided with electric lamps serving as heaters and a fan to create a blast.

778,897. MOTOR CONTROL FOR HOISTING BUCKETS; Lewis J. Robb and William M. Rosewater, Pittsburg, Pa. App. filed Dec. 19, 1903. By a single movement of the operating device in one plane, two motors can be driven in unison in either direction or one of them held at rest while the other is driven in either direction.

778,911. AUTOMATIC SUSPENSION AND CONTACT APPLIANCE FOR ELECTRIC ARC LAMPS; John Stevenson, Jr., Portobello, Scotland. App. filed Dec. 22, 1903. Details.

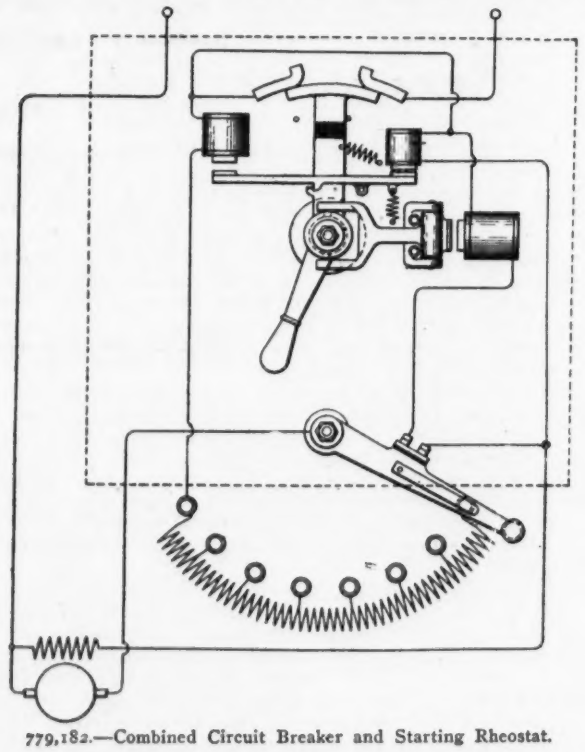
778,913. RHEOSTAT FOR ELECTRIC ARC LAMPS; Bernard A. Stowe, Cleveland, Ohio. App. filed Oct. 28, 1903. Segments of insulating material assembled to form a ring and having peripheral grooves containing a coil of resistance wire.

778,916. ILLUMINATED ADVERTISING APPARATUS; Alexander Stumm, Offenburg, Germany. App. filed July 1, 1904. A glass front is translucent in some places and opaque in others, while the space behind is divided into compartments containing electric lamps which are to be lighted by means of a selective switch to give the appearance of moving pictures.

778,933. TROLLEY CATCHER AND RETRIEVER; Charles F. Wilson, New Y. App. filed Aug. 19, 1903. Details of a ratchet and spring drum device.

778,971. ELECTRIC BURGLAR ALARM; Franklin S. Holmes, New York, N. Y. App. filed May 17, 1904. Consists in so arranging at the protective office and a protected structure distributed resistances variable at will in a protective circuit actuated from a common source of current so that it becomes impossible to tamper with the protective circuit without detection.

778,984. ELECTRIC LAMP BRACKET; Edwin H. Lux, Logansport, Ind. App. filed June 10, 1904. A metal bracket having flanges fitting to a beam or similar structure and carrying a pin for the attachment of a hickey.



779,182.—Combined Circuit Breaker and Starting Rheostat.

778,987. TROLLEY; Wm. W. Mercer, Norfolk, Va. App. filed May 28, 1904. Details.

779,003. AUTOMATIC MAGNET CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed June 28, 1901. One of a number of coils operates to control the switch restraining means and a coil of constant polarity co-operates with another of said coils to control the said restraining means.

779,004. MULTIPLE-TRANSFER SWITCHBOARD; Charles B. Smith, New York, N. Y. App. filed May 8, 1900.

779,054. ELECTRIC GENERATING UNIT; Sterling Shaw, Jacksonville, Ill. App. filed Aug. 29, 1899. An electric generating unit comprising a dynamo or dynamos, two driving engines and electro-magnetic couplings, the last being used to connect and disconnect the engine while the dynamo is running at speed, as may be required.

779,066. INSULATED RAILWAY RAIL JOINT; Bancroft G. Braine, New York, N. Y. App. filed March 29, 1904. Details.

779,072. SAFETY GAS COCK; Benjamin F. Clarke, San Francisco, Cal. App. filed March 14, 1904. An alarm circuit is energized when the gas is turned on and is automatically de-energized if the gas is properly ignited, but if not, the alarm continues to sound.

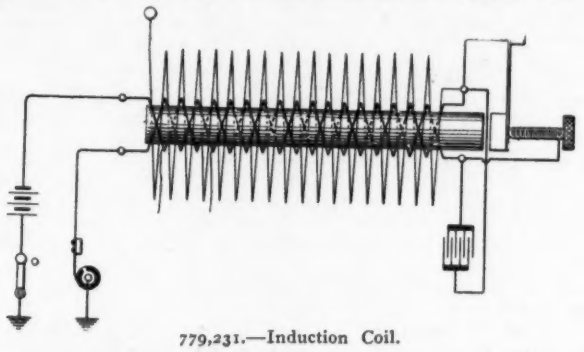
779,075. BLOCK SYSTEM; Antonio Fiorini, Pontremoni, Italy. App. filed April 13, 1904. Details.

779,098. ELECTRIC PLUG; Nelson H. Raymond, Brooklyn, N. Y. App. filed April 13, 1904. The contacts of the plug are formed by metal disks alternated by cylindrical blocks of insulating material, metallic rods extending longitudinally to the respective disks and terminating at a connection plate in the hollow handle of the plug.

779,150. THIRD RAIL SYSTEM; Giosue D'Esposito, Pittsburg, Pa. App. filed March 12, 1904. Details.

779,182. COMBINED CIRCUIT BREAKER AND STARTING RHEOSTAT; Robert H. Read, Schenectady, N. Y. App. filed Oct. 28, 1903. Means for compelling resistance to be cut in before the circuit breaker can be closed.

779,199. MOTOR CONTROLLER; Charles E. Barry, Schenectady, N. Y. App. filed Sept. 24, 1903. By this controller the operator can, on the



779,231.—Induction Coil.

initial moving of the controller handle, either throw the motors into series first or into parallel first, depending upon the conditions under which the train is to be started.

779,204. ELECTRIC RAILWAY SYSTEM; George L. Campbell, Nyack, N. Y. App. filed Oct. 11, 1902. The covers of switch boxes in the roadbed are built up of magnetic and non-magnetic laminations with a view to increasing the effective pull of the magnet on the car upon the switch operating armature in the box.

779,206. CONTROL SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Sept. 24, 1903. A controller comprising a plurality of groups of separately actuated contacts, a control system arranged to secure the operation of the contacts of one group and mechanism arranged to be operated with the last contact of the first group for operatively connecting the control system to another group of contacts.

779,222. DUST PROOF AUTOMATIC CIRCUIT CLOSER AND OPENER; Ulysses G. King, Harlan, Ia. App. filed April 9, 1904. The device is actuated by weights attached to levers in a rotating drum, the connections extending out through the axis of the drum.

779,223. KEYBOARD TELEGRAPHIC TRANSMITTER; Maximilien Kotyra, Paris, France. App. filed March 21, 1904. A machine in which the Morse characters are transmitted by merely pressing upon a key lever corresponding to the respective characters.

779,231. INDUCTION COIL; John G. Meyers, East Providence, R. I. App. filed Aug. 4, 1904. The primary coil is wound in sections connected in series, with the vibrator interposed between two sections and the condenser bridging the contacts of the vibrator.

779,247. APPARATUS FOR TESTING ELECTRICAL RESISTANCES; John B. West and Frederick M. Du Bois, Syracuse, N. Y. App. filed Jan. 2, 1904. A combination of two induction coils having their primary windings electrically connected in series, one of the windings being adjustable to vary the current in its secondary, a device to indicate the degree of the adjustment, testing terminals and a current strength indicator both connected in parallel with the secondary of one of the coils.

779,265. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; Frederick M. Conlee, Madison, Wis. App. filed May 21, 1904. A strap of resilient conducting material is looped about the end of a stud and has a brush rigidly secured to its free end.

779,267. CURRENT CONTROLLING SYSTEM; Arthur C. Eastwood, Cleveland, Ohio. App. filed Aug. 9, 1904. A system including a motor, current limiting means therefor, including automatic switches, having a winding connected so that their operation depends on the current flow through the limiting means, said means being cut into circuit with the motor when a certain maximum of current flows and cut-out upon the flow of a certain minimum current.

779,326. DEVICE FOR PREVENTING THE FORMATION OF SCALE IN BOILERS; Alexander Stewart, Chicago, Ill. App. filed Feb. 12, 1904. A compound magnetic arrangement placed in contact with the tubes of the boiler.

779,376. AUTOMATIC MAGNETIC CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed May 27, 1899. A circuit breaker for protection in a system such as a mining locomotive receiving current somefrom a trolley wire and at others from a storage battery carried on the vehicle.

779,390. SIGNALING FOR RAILWAYS; William S. Berry, Pittsburg, Pa. App. filed May 25, 1903. In systems where the signals are operated by the trolley current, the signal magnets are protected against variations of such current by the automatic interposition of resistance.

779,401. TROLLEY POLE CONTROLLER; Arthur W. Harrison and Eugene H. Fosdick, Los Angeles, Cal. App. filed June 2, 1904. The trolley base contains an air chamber and carries a solenoid by which the pole can be drawn downward and its motion controlled.